RUTENBERG DESIGN INC.

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DESIGN, DEVELOPMENT, AND TESTING OF AN INTEGRATED COMMUNICATION SYSTEM FOR THE SENSORY AND SPEECH IMPAIRED AT TRANSPORTATION TERMINALS

PREPARED FOR:
TRANSPORTATION DEVELOPMENT CENTRE
TRANSPORT CANADA

BY:
U. Rutenberg
RUTENBERG DESIGN INC.
LACHINE, QUEBEC

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Un sommaire en français de ce rapport est inclus avant la Table de matières.

PROJECT TEAM

The project team for COMMUNI-CAID was:

RUTENBERG DESIGN INC.:	Uwe Rutenberg
	Michael Barber
	Dirk Mietzker
CSTR	
Centre for Speech Technology Research:	Craig Dickson
	Dr. Stephen Eady
	Alan Wynrib
	Jocelyn Clayard
Teklogix Inc.:	Lawrence A. Cragg
	Paul Hays
	Ken Draper
	John Wiltshire

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Uwe Rutenberg

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9. Performing Organization Name and Address
RUTENBERG DESIGN INC.
130 - 18th Avenue
Lachine, Quebec H8S 3P7

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Suite 601, West Tower
Montreal, Quebec H2Z 1X4

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16. TDC Project Officer
John H. Morgan

17. Abstract

This report describes the design, construction, and human-factor evaluation of an integrated communication system for hearing, speech, and sight impaired travellers in transportation terminals. COMMUNI-CAID was designed as a two-sided open kiosk, with one side accessible to the travellers, the other to an operator.

The COMMUNI-CAID prototype was installed at Vancouver International Airport and functioned between May 1986 and March 1987. During EXPO 86, it was run by two operators from 9 am - 5 pm every day. Approximatively 1200 communication-impaired people and 3000 other travellers used the prototype. COMMUNI-CAID provided hearing and speech impaired people with site-specific travel information in the form of visual menus on a color monitor. It provided sight impaired people with the same information, using synthesized speech and enlarged keywords on a screen. People with motor disabilities and those in wheelchairs accessed the visual and audio information through large control buttons.

The four flight scheduling systems of Vancouver International Airport were displayed on one monitor, a feature greatly appreciated by the general public. A human-factor evaluation revealed an enthusiastic endorsement of COMMUNI-CAID by the disabled; it also revealed the need for improvement in the areas of screen contrast, design of controls, number of monitors, dialogue sequence, noise level, and glare.

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RUTENBERG DESIGN INC.
130 - 18ième avenue
Lachine, Québec H8S 3P7

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16. Agent de projet — CDT

J.H. Morgan

17. Résumé

Ce rapport décrit les travaux de conception, la réalisation et l'évaluation ergonomique d'un système intégré de communication à être placé dans les installations terminales dans le but d'aider les voyageurs ayant une déficience auditive, visuelle ou de la parole. Ce système, appelé COMMUNI-CAID, emprunte la forme d'un kiosque cylindrique ouvert sur deux côtés, l'un recevant les voyageurs, l'autre réservé au personnel. Mis en service expérimental à l'aéroport international de Vancouver, le prototype de ce système a fonctionné de mai 1986 à mars 1987. Durant Expo 86, deux préposés y étaient affectés tous les jours de 9 h à 17 h. Le système a été utilisé par quelque 1 200 voyageurs handicapés et 3 000 autres. Il fournissait aux handicapés auditifs et de la parole des renseignements spécifiques affichés sur écran couleur, auxquels on avait accès grâce à des menus d'interrogation. Aux handicapés visuels, l'information était livrée grâce à un synthétiseur de la parole et à des mots clés agrandis sur l'écran. Des boutons de grand diamètre étaient prévus pour les voyageurs ayant une incapacité motrice et pour ceux en fauteuil roulant. Les horaires d'arrivée et de départ des quatre sociétés aériennes desservant l'aéroport international de Vancouver étaient affichés sur un écran distinct, service grandement apprécié par le public en général. Les résultats de l'évaluation ergonomique ont montré que l'accueil des utilisateurs a été très favorable, mais aussi que des mises au point sont nécessaires: contraste des images sur les écrans, conception des boutons, nombre d'écrans, langage utilisé dans les menus, niveaux sonores et lumineux.

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SUMMARY

As a result of an unsolicited proposal, a contract was awarded to RUTENBERG DESIGN INC. in 1984 to design, develop and test an Integrated Communication System at Transportation Terminals for the Sensory and Speech Impaired (UP-R-212). The project was sponsored by the Transportation Development Centre of Transport Canada, the Unsolicited Proposals Fund, Supply and Services Canada, and the Cabinet Committee for Economic and Regional Development as part of the Transportation for Disabled Program.
A study entitled "Human Factors of Technical Aids for Communication Impaired Travellers" (TP5113E 1983) by Les Designers Douglas Ball Inc. revealed that there are no technical devices available in transportation terminals to cater to the particular needs of communication impaired travellers.

Communication impairment does not apply only to the deaf, blind and mute, but also to the wheelchair user with motor deficiencies and to the elderly, with a natural degeneration of hearing, seeing, and reaction time.

The overall objective, therefore, was to make transportation terminals more information accessible and specifically to develop a communication/information system that would not only provide travel information to the target group according to their needs, but also decrease their dependence on others when travelling.

The proposed concept aimed to combine high technology with a sound human ergonomic design approach.

Specific user groups were identified. Their requirements were analyzed, state-of-the-art technology was examined, and operational conditions were explored.

The following five target groups emerged, constituting the majority of the communication impaired population:

1. Speech impaired
2. Hearing impaired
3. Sight impaired
4. Motor impaired and wheelchair users
5. Elderly

In the early stages of the development, discussions with personnel at Vancouver International Airport resulted in a plan to test such a system during EXPO 86.

The database development was therefore focused on its application to this airport. It was determined that site specific information would be provided, including flight schedules and ground transportation sources, as well as information about hotels, EXPO 86 and Canada Pavilion. During the design process, the project steering committee decided that data relating to airline reservation procedures should not be included.

After deliberation over several approaches, the final concept for the prototype was arrived at. The design for COMMUNI-CAID was a semi-private cylindrical free-standing kiosk with a large opening for travellers on one side, and a smaller restricted entrance for the operator on the other side. The kiosk featured a tubular steel frame filled with soft vinyl panels, head height when seated, open mesh above this line, and a translucent ceiling to control the light level inside the kiosk. All interior components - housing computers, monitors, controls, printers, wiring, etc. - were constructed of wire mesh, steel, and wood painted a neutral beige.

Selected to operate the prototype were two students with a good aptitude for modern technology and keen motivation to work with disabled travellers.

The technology used for the prototype was based on the IBM-AT, with a 10 megabyte hard disc for data storage and a flopy disc as program driver. A 14" Gigatec colour monitor was chosen for its high colour resolution, and a monochromatic Zenith 11" monitor to display all flight schedules.

- A Hewlett-Packard high-speed laser printer was selected to produce printed matter. The system was accessed by 75 mm (3") push buttons and, to keep operations simple, a modified keyboard consisting of only numbers, capitalized letters, and a spacebar. Four sets of four push buttons accessed flight arrival data; four others, departure data.

The operator side was equipped with a 28 cm (11") standard IBM monochromatic monitor and a standard IBM keyboard, which was used for two purposes: 1) to conduct a "dialogue" with the traveller 2) to make program changes.

The use and operation of COMMUNI-CAID can be described as follows:

> When a traveller entered the kiosk, a photocell was automatically activated, which triggered an audio introduction in English and French. For the sight impaired, this feature alerted them to the availability of audio information.For the hearing and speech impaired, the introduction was displayed on the screen.
>
> The traveller faced the control console, which had two monitors - one for flight schedules and one for airport information. The visual menus were accessed through large push buttons on the keyboard. The sight impaired traveller used a headset to receive information in synthesized speech. To obtain hard-copy maps of the airport, travellers selected "print". If required, an operator could be summoned.

During the test period, the operators collected data on logsheets from almost every sensory impaired user.

In addition, a methodological human-factors evaluation was carried out with a number of selected subjects to analyze effectiveness of this new application of technology.

The evaluation revealed enthusiastic endorsement by the disabled. However, it also pinpointed the need to improve certain features such as screen contrast, the number of controls and monitors, menus and language sequence, noise level, speech quality, and light reflection.

Unequivocally, the target population felt that this high technology equipment could certainly increase their independence in travel.

In this first phase, the role of the operator served its purpose in soliciting travellers, encouraging the use of many components of the system, assisting through dialogue, and collecting data. However, the cost of manning a permanent system would be a factor to consider.

From an operational point of view, it seems necessary to eliminate the operator. The need for dialogue could certainly not be eliminated, but the problem could be addressed in the form of a portable communicating device.

The most desirable next step for COMMUNI-CAID seems to be an independent and more compact, simpler unit with access for the sensory impaired on one side and the general public on the other.

SOMMAIRE

En 1984, le Centre de développement des transports de Transports Canada a signé avec la firme RUTENBERG DESIGN INC. un contrat consécutif à la proposition spontanée de cette dernière (UP-R-212) pour l'étude, la réalisation et l'essai d'un système intégré de communication à être placé dans les installations terminales afin d'aider les voyageurs ayant une incapacité sensorielle ou de la parole.

Dans son étude de 1983, intitulée "Human Factors of Technical Aids for Communication Impaired Travellers" (TP5113E), la firme Les Designers Douglas Ball Inc. a révélé qu'il n'existait en effet aucune sorte d'aide pour les voyageurs souffrant d'un handicap de la communication.

Dans cette catégorie de handicapés sont groupés non seulement les sourds, les aveugles et les muets, mais également les personnes ayant une incapacité motrice (en fauteuil roulant, par exemple) ainsi que les personnes qui, en raison de leur âge avancé, souffrent d'une dégénérescence de leurs facultés sensorielles et de réflexes ralentis.

Le but de ce projet était donc de réaliser un système d'information et de communication destiné non seulement à mieux renseigner les voyageurs appartenant aux groupes cibles, mais aussi à accroître leur autonomie en voyage.

En plus d'exploiter des techniques de pointe, ce système devait être soigneusement étudié sur le plan ergonomique.

Des groupes cibles ont été identifiés, leurs besoins spécifiques analysés, les technologies de pointe susceptibles de répondre à ces besoins étudiées et enfin les conditions d'exploitation éventuelles explorées.

Dans les cinq groupes cibles repérés se retrouve la majorité de la population ayant un handicap de la communication, c'est-à-dire les personnes:

1. ayant une incapacité de la parole;
2. ayant une incapacité de l'ouïe;
3. ayant une incapacité de la vue;
4. ayant une incapacité motrice (en fauteuil roulant, par exemple);
5. âgées.

Dès le début de l'étude, il avait été convenu avec les responsables de l'aéroport international de Vancouver que le système y serait mis en service expérimental durant Expo 86.

La base de données constituée a donc été axée sur cet aéroport et ses aménagements. Il a été par ailleurs déterminé que l'information devant être véhiculée par le système porterait spécifiquement sur: les horaires des avions, les transports terrestres, les logements disponibles, Expo 86 et le Pavillon du Canada. En cours d'étude, le comité de direction a décidé d'exclure l'information sur les formalités de réservation de places à bord des avions en partance.

La forme du kiosque COMMUNI-CAID a fait l'objet d'études approfondies qui ont débouché sur une option réalisée en version prototype. Il s'agit d'un kiosque cylindrique indépendant doté de deux entrées: d'un côté, une grande ouverture pour les voyageurs et, de l'autre, une plus petite pour le personnel. Ce kiosque comporte une charpente tubulaire en acier, habillée de panneaux souples en vinyle jusqu'à une hauteur correspondant à la tête du voyageur assis et, au-dessus, de panneaux en métal déployé, le tout recouvert d'un plafond translucide filtrant la lumière qui pénètre à l'intérieur. Quant à l'aménagement intérieur abritant les accessoires tels que ordinateur, écrans, pupitre de commande, imprimante, câblage, etc. - il est réalisé en métal déployé et en panneaux d'acier et de bois couleur beige neutre.

Deux étudiants doués pour les équipements techniques et ayant la motivation voulue pour aider les voyageurs handicapés ont été recrutés afin d'exploiter le système durant Expo 86.

Le système s'articule autour d'un ordinateur IBM-AT (avec une mémoire 10 mégaoctets sur disque dur et une unité de disque souple) et de deux écrans (un Gigatec couleur de 35 cm [14"] choisi à cause de sa haute résolution et un Zenith monochrome de 28 cm [11"] affichent les horaires).

En outre, une imprimante rapide Hewlett-Packard à laser permet d'obtenir des sorties sur papier. Le voyageur a accès au système grâce à des boutons de 75 mm (3") de diamètre et un clavier très simple comportant des touches pour les chiffres et les lettres majuscules et une barre d'espacement. Sur le côté, on trouve quatre boutons donnant accès aux horaires des arrivées des avions et quatre autres aux horaires des départs.

Le préposé dispose d'un écran monochrome IBM de 28 cm (11") et d'un clavier IBM standard qui lui permet de "dialoguer" avec le voyageur et aussi de modifier le programme, si besoin en est.

Voici comment fonctionne le système COMMUNI-CAID:

> Lorsqu'un voyageur entre dans le kiosque, une cellule photo-électrique commande automatiquement l'émission d'un message de bienvenue en anglais et français. Dans ce message, les personnes ayant une incapacité visuelle sont invitées à coiffer le casque d'écoute; pour celles ayant une incapacité de l'ouïe ou de la parole, le message est affiché sur l'écran.
>
> Face à la console, le voyageur trouve deux écrans, l'un affichant les horaires, l'autre le renseignant sur les aménagements de l'aéroport. Les menus d'interrogation sont actionnés grâce aux boutons de grand diamètre. La personne ayant une incapacité visuelle se sert d'un casque afin d'écouter l'information donnée par un synthétiseur de la parole. Pour obtenir sur papier une carte des aménagements, il suffit d'appuyer sur la touche "print". Si besoin est, l'aide d'un préposé peut être sollicitée.

Durant la mise en service expérimental, les préposés ont recueilli, grâce à un questionnaire, des données sur tous les utilisateurs. En outre, l'évaluation du système au point de vue ergonomique et sur le plan de ses caractéristiques fonctionnelles a été faite grâce au concours de sujets sélectionnés.

L'expérience a révélé que l'accueil des utilisateurs a été très favorable, mais aussi que des mises au point sont nécessaires: contraste plus prononcé des images sur les écrans, réduction du nombre de boutons et d'écrans, langage portant moins à confusion dans les menus et les choix à opérer, réglages des niveaux sonores et lumineux et dispositif vocal de meilleure qualité.

Unanimement, les groupes cibles ont estimé que ce système de haute technologie les rendrait certainement plus autonomes dans leurs déplacements.

Au cours de cette exploitation expérimentale, le préposé a joué un rôle important: inviter les voyageurs à utiliser le système, encourager ceux-ci à en manipuler les accessoires, leur venir en aide en dialoguant avec eux et recueillir des informations utiles. Cependant, le coût généré par un préposé dans une installation permanente est un facteur sur lequel il y a lieu de réfléchir.

Du point de vue économie d'exploitation, il semble impérieux d'éliminer le recours à un préposé permanent. Afin de contourner le problème, on pourrait envisager l'adoption d'un dispositif de communication portatif permettant à l'utilisateur de s'adresser à un agent des lignes aériennes ou encore de l'aéroport.

Le perfectionnement du système COMMUNI-CAID semble de préférence passer par la mise au point d'une version plus compacte, plus simple et totalement automatique qui servirait tant les personnes ayant une incapacité sensorielle que le public voyageur en général.

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1.0 INTRODUCTION

1.1 Background

As a result of an unsolicited proposal, a contract was awarded to RUTENBERG DESIGN INC. in 1984 to design, develop and test an Intergrated Communication System for the Sensory and Speech Impaired at Transportation Terminals (UP-R-212). The contract was sponsored by the Transportation Development Centre,the Unsolicited Proposals Fund, Supply and Services Canada, and the Cabinet Committee for Economic and Regional Development as part of the Transportation for Disabled Program.
Previous studies, entitled "Human Factors of Technical Aids for Communication Impaired Travellers" (TP 5113 E, 1983) by Uwe Rutenberg for Les Designers Douglas Ball Inc., and "Communication Aids for Travellers with Visual/Hearing/Speech Disabilities" (TP 3941 E, 1982) by the IBI Group, revealed that there were no technical devices available in transport terminals to cater to the particular needs of communication impaired travellers.

Communication impairment does not apply only to the deaf, blind, and mute but also to the wheelchair user with motor deficiencies and the typical elderly with a natural degeneration of hearing, seeing, and reaction time.

The overall objective was therefore to make transportation terminals more information accessible. The specific objective of this project was to develop a communication/information system which would not only provide essential travel information to the target group according to their needs but also decrease their dependance on others when travelling.

The proposed concept aimed to combine high technology with a sound ergonomic design approach.

2.0 TARGET POPULATION ESTIMATES

This section presents an estimated number of the sight, hearing, and speech impaired target group in Canada. The numbers do not include the age group of 0 - 14, as these persons generally do not travel alone and hence are not potential COMMUNI-CAID users.

Sight Impaired	Under 65	96,300
	Over 65	114,400
		210,700
Hearing Impaired	Under 65	579,000
	Over 65	386,000
		965,000
Speech Impaired	Under 65	95,000
	Over 65	111,000
		206,000

The total number of all sensory impaired is estimated at 1.4 million, representing 5.7 % of the Canadian population.

It must be noted that these estimates refer to the population with severe impairments, but the additional group of elderly with less severe impairments would also benefit from the aids and technology implemented for the target group.

The population of those over 65 years is expected to increase significantly in the next decades.

2.1 Potential Travel Demand

Based on travel data published by Statistics Canada, the annual inter-city rate of trips via public carriers in Canada is 2.3 trips per capita for non-business trips, and 1.5 business trips per adult under 65 years of age.

To provide a more significant perspective, an estimate was made of the potential number of travellers from the target groups who would use the airports across Canada. These estimates should be viewed with caution, however, since a number of assumptions had to be made, such as:

- the sensory impaired would have the same modal split (e.g., travelling on a bus, rail or in the air) as the general population
- adults over 65 years would have half the number of non-business trips as the general population

The estimates are therefore presented primarily as an illustration of the potential scope of communication needs for sensory impaired travellers.

Airport	Sensory Impaired Traveller/Day	
	Target Group	Additional Group
Toronto International	770	1900
Montreal (Dorval)	380	930
Vancouver International	370	900
Calgary International	220	530
Halifax International	90	220
Quebec	40	90
Regina	40	90
Fredericton	12	30

Potential Travel Demand by Target Group

Mode	Non-Business	Business	TOTAL
Air	685,000	391,000	1,076,000
Rail	241,000	7,000	248,000
Bus	1,584,000	48,000	1,632,000
			2,956,000

Potential Travel Demand by Additional Group

Mode	Non-Business	Business	TOTAL
Air	1,598,000	1,015,000	1,613,000
Rail	562,000	18,500	580,500
Bus	3,695,000	123,500	3,818,500
			7,012,000

3.0 INFORMATION/COMMUNICATION NEEDS

Two factors are vital for any inter-city traveller: access to the transportation mode and access to information/communication systems. For all travellers, information must be provided and communication carried out in a format compatible with the abilities of the travellers.

The general travelling population typically has the option of receiving information in visual or audio form and can adapt to varying degrees of information quality, such as concentrating on a P.A. announcement by blocking out other sounds. These travellers can also communicate by speaking or by reading and writing.

The sensory impaired population, however, has a more limited set of options for receiving information and for communicating.
This leaves many travellers in this group with only two alternatives: to travel with a companion who plays the role of one of the impaired senses or to rely on antiquated methods of paper and pencil and awkward identifications to the dialogue partner (e.g. airline agent). A person with multiple disabilities has an even greater restriction in communication.

Unlike wheelchair users, whose impairment is easily identifiable, the sight, hearing, and speech impaired population must often undergo embarrassing procedures to identify their impairment to others.

The specific characteristics and requirements of the different groups are outlined in the next paragraph.

4.0 USER CHARACTERISTICS AND REQUIREMENTS

4.1 Characteristics of the Hearing Impaired

In this group, the following levels of hearing impairment can be found:

1. Total deafness
2. Perception of sound, but indistinguishable
3. Reduced hearing in both ears
4. Hearing with one ear only

For the totally deaf, the problem is not only the lack of perceiving audio signals but the lack of audio stimuli that compose daily life situations. Very often, undeveloped speech is combined with this impairment, due to the lack of feedback and the inability to control it.

Deaf people rely heavily on their vision to perceive information, e.g., sign language, lip reading, written text, symbols. Some hearing impaired people perceive noise and can make a distinction between loud and low intensity but cannot distinguish words.

For people with reduced hearing in one or both ears, an increase in volume intensity can usually help; e.g., amplifying earpieces, phones, etc. When the hearing reduction or loss is in one ear, the result is not only lack of perception on that side but lack of three-dimensional location of the sound source.

Requirements of the Hearing Impaired

For the hearing impaired to access information, the following elements were considered:

- clear visual messages of all audio information essential in a terminal (e.g., boarding calls, flight schedule changes, etc.)
- information at central point(s), visible from all directions
- clearly displayed reference points and pathways (e.g., to gates, floor levels)
- additional hard copy of information (e.g., maps, lay-outs), which would greatly decrease dependency
- for dialogues, an interchange of visual messages
- unobstructed view of dialogue partner and controlled light level to see partner
- fast, logical access to general information, using familiar input devices (e.g., keyboard, pushbutton knobs)
- emergency messages transmitted through colour, flashing lights, vibrations
- volume amplifying devices
- sound source shielded from environmental noise
- excellent voice quality
- stereo sound

- sound adjustment for loud-low
- pitch adjustment for high-deep
- dialogue could be conducted if the other person knows sign language and/or the impaired can lip read. Both modes are difficult to implement in a travel environment.

4.2 Characteristics of the Speech Impaired

Speech impairment is usually related to other impairments: to individuals in wheelchairs as a cause of injury to their nervous system, and to the deaf because of the lack of audio feedback. Another impairment can be stuttering, which requires a slower pace of communication.

Another aspect in this context is the language impaired traveller, that is, one who cannot speak either English or French and whose language has a totally different base, such as Chinese, Japanese and Slavic languages. A Spanish-speaking traveller can understand some French words because the two languages share a common Latin background. However, the Japanese traveller cannot even find a similarity in the letters.

Requirements for Speech Impaired

The following elements were considered to aid the speech impaired:
- effective devices to produce a visual or audio output for the dialogue partner
- an unobstructed view of the dialogue partner
- adjustable pace when the speech impaired person is transmitting his/her voice
- clear audio information by technical devices or dialogue partner

Requirements for the Language Impaired

To transcend language barriers, the following requirements were established:
- short, concise translation for receiving and transmitting own language
- translation at key points in the terminals, e.g., information, security, customs, immigration, check-in
- input devices familiar to all cultures; e.g., calculator patterns, typewritten lay-out, etc.

4.3 Characteristics of the Sight Impaired

The blind traveller receives information in two ways - through hearing and through tactile sensors (fingers, hands, skin and feet for textures, temperatures, wind directions, echoes, shapes, etc.)

Blind travellers often use seeing-eye dogs or canes. The dogs usually cannot detect barriers above their height, such as protruding counters, safety ropes, etc. For this purpose, the traveller uses a cane in a sweeping motion in front of him or herself.

The sight impaired traveller can detect dark or light but might have reduced peripheral vision, a reduction of perception of the right and left sides; tunnel vision, a reduction in lateral and horizontal sight-lines where only the centre appears sharp and the surroundings are blurred; or he/she may wear strong corrective lenses, which reduce lateral sharpness and can distort vision at certain angles.

A small percentage of the population is colour-blind and cannot distinguish between green and red tones.

For people who are blind in one eye, the three-dimensional effect is virtually lost.

Only 10 % of the sight impaired population is able to read Braille.

Requirements for the Sight Impaired

The following considerations were deemed necessary to implement access of information for the sight impaired:

- clear, concise audio messages for information; not more than 5 - 7 items per unit for selection and memory
- speaking to the sight impaired individual face to face in a clear voice rather than speaking behind or beside him/her
- reference points for orientation provided in audio form; e.g., "Proceed in 6 o'clock direction."
- an audio receiver in a familiar form/shape; e.g., telephone receiver
- standard patterns for numeric input same as telephone, calculators, typewriter
- component within reach on horizontal surface when traveller is standing or sitting
- texture differentiation for different functions; e.g., help button with rippled texture, and bright colour contrast for those with limited vision
- place for seeing-eye dog, cane, etc.
- no protruding elements from the waist up
- stable components: anti-slip standing surfaces, non-movable components (telephones, keyboards, signs)
- no unpredictable movement of elements such as chairs, armrests, etc.
- information kiosk situated outside main traffic flow
- hard surfaces to stand and walk on rather than carpets, which eliminate audio feedback
- no green or red indicators for the colour-blind
- no blue light (short wave lenght, lesser depth of field)
- no glare, reflections, or flickering on screens
- bright lighting for key areas such as control buttons, phones, etc.
- sharp contrasts, such as black and white text, and/or adjustable contrast

4.4 Characteristics of the Wheelchair and Motor Impaired

People with motor impairments are generally confined to wheelchairs. The cause of their impairment can be any of the following:

1. paralysis
   paraplegic - lower limbs partially or totally affected
   quadraplegic - all four limbs affected
   hemiplegic - one side of the body affected with partial or local paralysis
2. spinal injuries and other back ailments
3. deformities of the spine, hip, or pelvis
4. amputations or artificial limbs
5. loss of joint mobility due to rheumatoid arthritis and other muscolosceletal diseases
6. loss of controlled movement, such as spastics, and those with multiple sclerosis and other types of motor coordination disorders
7. motor disorders - those who can move their limbs but cannot control them

The most significant problems for wheelchair users in terminals are level changes, long distances, viewing distance to monitors, and access to standard information devices, such as phones, counters, etc.

Sensory impairments are often combined with the use of a wheelchair, such as slurred speech and motor deficiencies. This makes standard input controls difficult or impossible to use.

Requirements for the Motor Impaired

The following elements were considered necessary to achieve effective communication for the motor impaired:

- table and workplace heights at 78 cm (31")
- lateral workspace at 106 cm (42")
- knee, armrest, and toe clearance

- ramps 1:12 for any level change greater than 0.6 cm (¼")
- hand reach 57 cm (22")

Hand controls

- large key pad
- ample distance between controls
- controls on horizontal or 0-15° inclined surfaces, not on vertical surfaces (for motor impaired)
- no fine finger controls such as turning, pivoting, sliding, twisting
- ample spacing between the keys on keyboards

4.5 Characteristics of the Elderly

Physique

For the elderly, standing height decreases as a result of greater slouch and compression of the fibrous discs between the vertebrae.

They experience loss of mobility due to structural changes in the joints and reduced muscle flexibility. These conditions limit the high and low reaches the elderly can attain with ease.

Their muscular strength decreases. At age sixty, a person has about 60 % of the strength he had at thirty.

Reaction time lengthens. At sixty, it is about twice that of age thirty.

Sensitivity to vibration may diminish.

Vision

At age sixty, the minimum focal distance (uncorrected) may be as great as 101.6 cm (40"). Also, acuity decreases for distant vision. Even with corrective lenses, normal vision may not be achieved.

Eye diseases increase, such as cataracts and retinal degeneration, which affect depth perception.

Ability to see in dim lighting is reduced.

Greater illumination relieves eye strain by reducing the pupil opening, thereby increasing the depth of focus and minimizing constant eye adjustment.

Colour perception changes; the world may look more blue to the elderly.

Hearing

Hearing loss becomes more acute with age. A child can hear a frequency of 20,000 Hz. At age thirty, a person can hear up to 15,000 Hz, and at age fifty, the limit is 13,000 Hz.

A loss of 45 decibels in hearing acuity makes it difficult for a person to make out direct conversation; a loss of 65 decibels makes it difficult to hear over the telephone.

Requirements of the Elderly

For the elderly, the following elements were considered to facilitate their access of information:

Physique

- components within close reach from standing and sitting position
- simple hand-finger and arm movements for controls; no strong gripping, wrist movements, precise fingerpointing, lifting, pulling or pushing
- visual and audio information equipment, with adjustable speed to allow sufficient reaction time, with the possibility of repetition
- no tactile-sensitive controls

Vision

- viewing distance for detailed visual information less than 23 cm (9")
- ambient light illumiantion level between 300-500 Lux for concentrated visual work on workplace
- task light up to 500 Lux
- no reflection on surfaces, screens, controls
- no short-wave length colours, such as blue

Hearing

- no frequencies over 13,000 Hz and under 60 Hz
- stereophonic sound
- ambient noise blocked out whenever possible
- clear sound source
- volume control
- visual back-up of audio information

5.0 DESIGN CONCEPT

5.1 Approach I

In the first design approach, the components which had been identified as necessary for the use of such a centre were laid out in a three-dimensional relationship (Fig. 1).

The proposed centre consisted of a semi-private space with approximately 120 cm (4'0") high walls and a suspended ceiling which would, through its shape and colour, attract travellers. The approach was operator oriented; that is, the station would be permanently staffed and convey a definite operator and traveller territory, separated by a counter/table.

The traveller could wait in a small area and retrieve information, approaching the counter and using visual and audio components with or without the assistance of the operator.

At first, the approach involved the airlines in making reservations, booking and ticket purchase. However, the members of the steering committee decided to eliminate carrier data and to proceed with only site-specific terminal information retrieval and dialogue. It was also felt that the dominating position of the operator in this design would discourage sensory impaired travellers from accessing information on their own. The size of the centre seemed too large and undefined for a central information point.

5.2 Approach II

Through a number of small scale models, more emphasis was placed on the input of the sensory impaired traveller and less on the operator.

A system was proposed and built in full-scale mock-up form which emphasized three levels of information retrieval by the traveller.

First level: The traveller would use only the periphery of the centre to access flight schedules displayed on a monitor 240 cm (8') high, with amplified sound and large letters displayed simultaneously.

Second level: The traveller would enter and retrieve site-specific information such as terminal lay-out, location of elevators, restaurants, washrooms, etc.

Third level: The traveller would ask the operator for help in communicating with the airline, e.g., ticket problems, lost baggage, checking in (Fig. 2).

5.3 Approach III

To simulate user interaction with each component, a second mock-up was built to scale.

Semi-transparent walls were simulated and the idea of a cylindrical shape with a floating ceiling was established. The cylindrical shape had a number of advantages. First, such a form is independent and can be positioned anywhere in a terminal. Second, its curved shape prevents travellers from running into or against corners. Also, the full size of the centre can be recognized from all directions. Third, it can be easily divided into traveller and operator territory, each having a separate entrance.

This approach was accepted by the steering committee members as a valid basis for the design of the final prototype (Fig. 3).

5.4 Prototype development

All major technical components such as monitors, CPU, printer, keyboard, control panels, etc., were verified for their capabilities and availability to meet the deadline of May 1986.

The software for the driving programs, the visual menu programs, and the audio synthetic speech were developed at the same time as the shopping list for the components was being compiled. Preliminary shop drawings were made to accomodate those components, determine the final design, and build the entire centre.

All technical components were mocked-up full scale to verify dimensions and interfaces with sensory impaired travellers' requirements (Fig. 4).

5.5 Prototype Building

The building of a prototype is a very time-consuming process, since most parts have to be custom made, and off-the-shelf parts for small quantities require long delivery times. The more complex a prototype is, the more these difficulties increase. In addition, the exposure to and use in a public environment compounded the problems in regard to protecting valuable computer equipment yet making controls and components accessible to travellers.

Except for certain items which had to be purchased, the majority of the parts for COMMUNI-CAID were built at the shops of Rutenberg Design Inc.

For shipping, assembly, and disassembly, sizes and weights of components had to be determined, and provisions made for trouble-shooting, repairs, and service. Before the prototype was shipped to Vancouver, it was completely assembled and demonstrated to the steering members on May 2, 1986. Two days later, COMMUNI-CAID was on its way to Vancouver International Airport, where it was assembled at level 3, in front of the Transport Canada Information booth.

5.6 Description of the COMMUNI-CAID Prototype

The COMMUNI-CAID station is cylindrical and measures 275 cm (9') in diameter and 330 cm (10') in height. Two curved side panels 180 cm (6'), partially enclose the station, leaving one wider opening of 145 cm (56") on one side for the user. On the opposite side, a narrower entrance of 181 cm (32") is for the operator. The ceiling is made of light-weight translucent material, to reflect ambient light. The upper part of the side panels are semi-transparent and provide visual and audio privacy without segregating. The lower part of the side panels are covered with soft vinyl. The floor is of resilient material, providing tactile feedback for cane users and the visually impaired. The station's simple geometric shape is easily recognizable, and its colours are appealing. Symbols and written signs in English and French identify the station.

The station is divided into two halves: one section for the traveller, the other for the operator. When the traveller enters the station, he/she faces the following components at table height:

- at the centre, one graphic colour monitor with large control buttons and a simplified table keyboard
- to the left, one monochromatic monitor for flight arrival and departure schedules, with push buttons for selection
- to the right, a digital clock with minute changes, and a hand phone for audio information
- under the table, a tray for hard-copy output
- 90° to the right, a regular touch-tone telephone and a visual ear (TDD)

The operator on the other side has the following components to work with:

- a monochromatic monitor
- a full function table keyboard
- a regular telephone to call airlines, security, etc.
- a writing surface
- the database, locked and secured

5.7 Use of COMMUNI-CAID

The centre is lit and ready for use at any time. COMMUNI-CAID introduces itself to travellers who can see and read in English or French by means of an INTRODUCTION LOOP, displayed on the graphic monitor. This introduction briefly describes what COMMUNI-CAID does, what information is available, displays on the screen a graphic picture of the components, and continues in English and French until the traveller chooses to start the information session. The traveller can chosse either language, and all further information is then given in that language. For travellers who cannot see, the same INTRODUCTION LOOP is presented in audio form in both languages.

5.7.1 VISUAL MODE

The traveller sits down in front of the monitor and can make choices on the screen by moving the cursor to a selected position. There are large push buttons in front of the screen labeled with arrows for "up", "down", "left", "right", and the centre "hit" button. The design and spacing of these push buttons is made to accomodate all travellers, including those with manual dexterity problems (arthritis, erratic hand and/or arm movements).

The cursor, when moved up or down on the screen, "snaps" from one position to the next, avoiding fine manipulation and simplifying hand-eye coordination.

On the menus, the written message is, whenever possible, reinforced by a symbol. For example, for airport facilities, the word "AIRPORT FACILITIES" appears with symbols; the same goes for WASHROOM, ELEVATORS, RESTAURANTS, etc.

These symbols are based on the Transport Canada standards to be used in airports. The traveller will recognize the same symbol on the screen as in the actual location. A graphic map of the chosen airport level will show the location of this facility with this symbol.

This same map can be obtained as a hard copy when selecting "PRINT". The copy will be printed in black and white and presented in a cut sheet, thus avoiding the need to tear paper, which can be difficult for travellers with manual dexterity impairments. These print-outs are available for all information which requires efforts in memory, e.g., location of facilities, orientation, etc.

If the traveller chooses flight departure and arrival information on the graphic monitor, a smaller monitor is switched on beside him/hee. At Vancouver International Airport, four separate video systems display flight arrivals and departures on four different monitors. COMMUNI-CAID brought this system together into one monitor, where the traveller can choose from among Air Canada, CP Air, Pacific Western, and Western Airlines.

The traveller can leave the COMMUNI-CAID centre at any time, as the system has a time-out of approximately two minutes, after which it returnes to the Introduction Loop.

5.7.2 AUDIO MODE

When a traveller enters the COMMUNI-CAID centre, he/she "trips" a photocell. This activates the INTRODUCTION AUDIO LOOP, with the same message as the visual introduction, which can be heard over a speaker in English and French. The loop is intended to make travellers who cannot read messages on the screen aware that there is an AUDIO MODE available for them.

The traveller can then choose between English and French. By picking up the head-set, the traveller can hear the same information that is given in the visual mode.

Simultaneously, amplified keywords of the audio menus are displayed on the colour monitor to reinforce the information.

The traveller will hear a maximum of five choices/menus from which to select at the end of each line. By the sound of a tone, he/she can touch any key on the keyboard or any push button. The volume on this mode can be controlled by a large dial on the table, directly in front of the headset.

The traveller using the audio mode can summon the operator for additional communication. When the information session is over, the system switches back automatically to the start and will start over only if the head-set is picked up again.

5.7.3 DIALOGUE MODE

If at any time during the information retrieval an operator is required for specific information such as personal ticket problem, delay, and/or change of plans, the traveller can summon the operator.

If the traveller chooses "OPERATOR ASSISTANCE" on the menu, a light at COMMUNI-CAID will pulse to alert the operator.

In the meantime, the traveller is asked, on the screen, to wait for the operator to arrive. During this waiting period (between 30-60 sec.), the traveller can conduct the dialogue from one of three different keyboards. For travellers able to use a standard table keyboard, there is a simplified one in front of them, consisting of capitalized letters, numbers, and a space bar.

For those with manual dexterity problems, there are two screen keyboards displayed on the monitor, one with a standard QWERTY lay-out, the other with an ABC lay-out. These keyboards can be used by moving the cursor on the screen to the selected letter and "hitting" the push button, thus composing words on the screen. For all three keyboards, the message typed is visible on the traveller's screen as well as on the operator's.

If communication with the airline is required for ticket changes, flight change, etc., the operator will type the essence of the dialogue. The operator will then send the traveller, along with this printed message, to the airline counter, where the traveller will not have to speak. The operator does not intervene in airline procedures but facilitates communication.

5.8 Installation

In the first days of May 1986, the prototype was assembled on level 3 at Vancouver International Airport near the Transport Canada Information booth.

Electrical power supply for one 110 volt AC, 20 AMP circuit, one local telephone line and four video channels for flight departure and four for arrivals had been installed by a local contractor. Fine tuning of the video channels was done by Transport Canada technicians.

As of May 10, 1986, COMMUNI-CAID was working successfully and according to schedule.

5.9 Operation

During EXPO 86 (from May to October 1986), COMMUNI-CAID was run by two operators seven days a week from 9 am to 9 pm. From October 15 to March 30, 1987, the centre was run by one operator from 9 am to 5 pm every day except Mondays and Tuesdays. Those days had been found to have the lowest passenger demand.

Since COMMUNI-CAID was a completely new product, never seen or advertised before, the operators had to fulfill many additional functions that would not be required under regular operating conditions. These were:

- to solicit and encourage potential passengers in the airport to use the system , one must remember that most sensory impairments are not visible, and only the most severe can be identified. Also, airlines do not have any records or indications of sensory impaired passengers, as they are generally accompanied by a companion who provides for all communication.

- to encourage the use of many or all components by each traveller to valuable feedback data; e.g., both visual and audio, French and English
- to establish contact with airline agents and make them aware of this service
- to follow up on contacts with local associations to send their members to try out COMMUNI-CAID
- to collect as much data as possible about people using COMMUNI-CAID
- to implement minor changes in menus; e.g., prices, telephone numbers, locations, etc.
- to keep the centre clean and maintain it in operating condition
- to switch the system on and off at the beginning and end of the day

From October 1986 - March 1987, when only one operator attended the station, the centre had to be locked when that operator was not present. Two plexiglass gates, strong but transparent, were built to protect the components but still allow passers-by to see the interior of the centre. On a panel outside the centre, a text in English and French explained the nature and purpose of the prototype.

5.10 Information Topics Provided in Visual and Audio Mode at COMMUNI-CAID

1. COMMUNI-CAID components - graphic display

2. Airport facilities

- elevators	levels 1, 2, 3
- escalators	"
- stairways	"
- washrooms	"
- telephones	"
- lockers	"
- restaurants, coffee shops	"
- currency exchange	"
- travel insurance	"
- airline ticket centre	"

3. Ground transportation
   - taxi
   - wheelchair taxi
   - regional bus
   - airport shuttle
   - Victoria bus
   - car rental
   - railroad services

3. Accessible hotels
   - Vancouver centre
   - Vancouver north
   - Vancouver south (Richmond)
   - Vancouver east (Burnaby, Coquitlam)

5. Associations in Vancouver area
    - Paraplegic Association
    - Hard of Hearing
    - Western Deaf Institute
    - CNIB

6. Flight arrival and departure
    - Air Canada
    - CP Air
    - Pacific Western
    - Western Airline

7. EXPO 86 and Canada Pavilion
    - facilities
        - washrooms
        - clinics
        - telephones
        - restaurants
    - transportation
        - skytrain
        - monorail
        - SCAT routes
        - wheelchair rental

5.11 Description of Technical Components

1. Gigatek Color Monitor, Model CCDI331STLP
   High resolution colour monitor with 14" screen, displaying all graphic menus, text menus, and amplified keyboards

2. IBM PC, Model AT
   Highly reliable and software compatible system with expansion for parallel ports and 10 Mbyte disk drive

3. IBM AT keyboard, Model 6450200
   Used by operator for communicating with traveller and by programmer for input/change of programs

4. IBM PC Monitor, Model 5151001
   Monochromatic 11" monitor for operator side and for use by programmer

5. Zenith Monitor, Model V2M123C
   Monochromatic 11" monitor for display of flight schedules on user's side

6. HP Laser Jet Printer, Model HP 2686A
   High-speed printer for black and white hard copies 8.5" x 11" with 1000 sheet of storage and tuner for 2000 copies. Print speed between 5-15 sec/copy

7. Table Keyboard, Model Teklogix TK142504
   This customized keyboard was used with a limited number of basic keys, eliminating lower cases, question marks, exclamation marks, colon, comma, brackets, parentheses, etc.
   This keyboard was used by the traveller to start English or French mode and to communicate with the operator.

8. Control panel with five push buttons, custom made
   Four buttons to command the cursor up, down, left and right, and one for select

9. 8-1 Multiplexing push-button box, custom made
   These controls were used to select between four arrival and four departure channels on the flight schedule monitor.

10. Realistic Amplifier, Model 31-1982B
    One component amplified the synthesized voice component; the other would amplify the digitized introduction voice.

11. Flashing Light Box
    This device provided the flashing light to summon the operator for assistance.

12. Realistic Headphones, Nora 40 Aural Douce
    These headphones transmitted the synthesized voice for the sight impaired traveller.

13. Fluorescent Display Alarm Clock, Canatian Tire
    This clock provided time in enlarged digits, changing every minute.

14. Ambient Lights, IKEA 75 W
    Four lights were used to provide even, ambient lighting.

15. Task Lights, IKEA Type "T", 25 W
    These lights provided intensified light levels at the hard-copy tray and at the controls.

16. Electric Eyes, Model 42 MRV-5000
    Three electric eyes with reflectors provided for a light switch, controlling the audio introduction mode.

17. Realistic Speaker 4", Model 40-1909 B
    One speaker transmitted the audio introduction in English and French.

18. Visual Ear, Northern Telecom, Model 2200
This is a telecommunication device for the deaf to be used in conjuction with the telephone and the same apparatus at the other end.

19. Telephone Set, Northern Telecom, Model Harmony
One set for the operator to communicate with airlines, one for the user for local calls and to use with the visual ear.

20. Office Chairs, Dix Versions
Two light five-star adjustable office chairs on castors, one for the user and one for the operator.

5.12 Technology Interface/Human Factors

With the application of high technology at workplaces and at home, most people of this target group are familiar with the personal computer, keyboard, diskdrive, mouse, lightpen, calculator, telex, fax, intercom, headset, and stereo system. Although a decade ago there was some reservation about this technology, today very little resistance is felt by users. Needless to say, it all depends on how the technology is presented to the user.

If complex technical appearances prevail, people are often intimidated. If, on the other hand, this technology is presented in an accessible form with materials, shapes, and controls that people are familiar with, there is less likelihood of intimidation. Also, the younger generation and people who are exposed to this technology while travelling accept it without question.

6.0 TEST METODOLOGY

During the eleven months of operation at Vancouver International Airport, data was collected by the operators. In addition, one ergonomic evaluation was carried out in July by Dr. Ruth Heron with a number of selected subjects. This report is shown as Appendix D.

Originally a short questionnaire was designed as part of the computer program to collect data from every person using the system.

After the first few days of operation it became evident that it was impossible to predict when a user would stop to use COMMUNI-CAID, so it was difficult to designate a point in the program where all users would come across this questionnaire.

It was therefore decided to have the operators fill out the questionnaires. They collected data on the user's impairment, the use of the system, the user's comments and suggestions, and included their own observations. The advantage of this method is that typical comments which come up in conversation can be recorded, whereas answering a questionnaire is considered by many users to be time-consuming and intimidating.

Another advantage is that the operator could encourage the user to try out components he/she originally had not intended to use to get some additional feedback.

The disadvantage, however, is that no data was collected when people used the system while the operator was not present; therefore, the total number of users recorded represents less than the actual number.

The following pages present a summary of comments made by the users and observations by the operators.

Approximately 1200 people were recorded to have used COMMUNI-CAID during the eleven months of operation.

The general public arrived in great numbers during EXPO 86 and were either referred to the nearby Transport Canada Information booth or their questions were answered by the COMMUNI-CAID operator. The nature of their questions was usually: location of washrooms, airline counters, banks, shops, restaurants, car rentals, buses, taxis. They would usually not sit down and take the time to go through the system. They used COMMUNI-CAID mainly for the flight schedule monitor.

6.1 Test Results

The average time a user would spend at COMMUNI-CAID was between 10-30 min.

The test results will be viewed within three different phases, since significant modifications and improvements were made during the eleven-month period.

PHASE I	May 1986 - July 1986 (EXPO 86)
PHASE II	July 1986 - October 1986 (EXPO 86)
PHASE III	November 1986 - March 1987

6.1.1 PHASE I

Problems encountered by operators listed in order of frequency:

1. Not understanding how to move cursor - by the keys on the keyboard or by push buttons?
2. Confusion about keyboard options - screen keyboard/table keyboard
3. Difficulty in locating the hard-copy print-out
4. Getting trapped in one language and not knowing how to return to other
5. Push buttons not close enough to the user

Other comments made by users:

Hearing Impaired

Improvements suggested:

- signs at centre should be bigger
- other signs should be at eye level
- booth should be bigger for two users
- glare on main screen from the light of the Transport Canada Information booth
- introduction too long
- TDD should be available at COMMUNI-CAID
- volume control for hand phone

Positive aspects:

- great concept
- visuals and graphics clear
- dialogue mode very helpful

Sight Impaired

Improvements suggested:

- introduction loop should mention chair
- everything should be labeled in Braille and raised letters
- audio takes too long to start after headphones are picked up
- print-out should be in Braille
- directions should be based on clock face; e.g. "Proceed in 3 o'clock direction."

Positive aspects:

- COMMUNI-CAID preferable to Transport Canada booth
- although voice is synthetic, no problem understanding
- place for seeing-eye dog important at COMMUNI-CAID, out of main traffic

Wheelchair and Motor Impaired

Improvements suggested:

- make local telephone on wall easier to reach
- entrance lip on kiosk floor 1.5 cm (5/8") too high for some wheelchair users

Positive aspects:

- visual information is clear
- push buttons are easy to access
- the system is self-explanatory
- system easy to use
- computers easy to work
- Canadian government is to be commended for spending money to improve information for the handicapped. The US should follow suit.

All Users

Improvements suggested:

- booth should say COMMUNI-CAID only, not "Information" or "Communication"
- push buttons should be labeled "CURSOR CONTROLS"
- introduction should be shorter
- system too slow for people in a hurry

Elderly

Improvements suggested:

- more detailed map for hotels
- print on monitor too small to read without glasses

Positive aspects:

- sitting down at COMMUNI-CAID is preferable to standing and lining up at the counter
- instructions for airport facilities are clear
- system is user-friendly

General Public

Improvements suggested:

- information should be given in more languages
- too slow for "fast information"
- keyboard should be located behind push buttons, not in front
- touch screen would be preferable
- green letters should be used on the screen, not blue
- flight monitor should show complete list of all airlines in the airport
- a "beep" should signal the completion of the print-out
- keyboard options should be more clearly defined
- booth should be more eye-catching from far

Positive aspects:

- great idea
- "warm feeling" for someone who has never used a computer before
- great concept, pleasing appearance and attractive colours
- very good to have flight monitor in one system
- good graphics
- good information on airport facilities

Operators

Improvements suggested:

- larger writing surface
- place for handbag
- computer main switch should be easier to reach
- EXPO information numbers should be included
- provide more "service for the handicapped" e.g., listing of local associations (make information more prominent, as many people do not read instructions, then complain)

Positive aspects:

- people are not afraid to walk into the station and use it
- no vandalism or misuse of the system
- general public streaming in to ask for information (approximately 40 % used the system, 60 % ask the operator)

Association Representative (CNIB volunteer)

Improvements suggested:

- provide a means for the blind to find COMMUNI-CAID
- hand phone should be labelled PHONE in Braille and have a shoulder rest to keep hands free
- system should have talking clock
- airport noise disturbing on audio mode

Positive aspects:

- system easy to use
- audio mode provides good information topics

Association Representative (Paraplegic Association)

- very useful system; it is great

Association Representative (Deaf Association)

- visual information excellent for the deaf; very clear and useful
- dialogue through the computer helpful and efficient

Association Representative (Air Canada)

- good idea, especially the print-out maps for the airport lay-out with facilities

Japan Airlines Representative

- for disabled Japanese travellers COMMUNI-CAID would be very helpful

Changes and Implementations after Phase I

The following is a list of design and hardware modifications and changes:

1. Purchase and installation of a TDD device (visual ear) to improve the service to the hearing and speech impaired users.

2. Design and fabrication of a ramp with anti-slip surface to overcome 1.5 cm (5/8") lip to kiosk entrance. The bright red colour served to visually emphasize the entrance.

3. Increased size of international symbols for "wheelchair", "sight impaired", and "hearing impaired" and mounting at the top of the station around ring, visible from all sides.

4. Smaller signs mounted at eye-level on station wall outside.

5. Hand phone, fluorescent red.

6.1.2 PHASE II

Problems encountered by operators, listed in order of frequency:

1. Difficulty finding location of print-out
2. Change from one language to another in mid-stream difficult
3. Keyboard options unclear
4. Introductions too long

Other comments made by users:

Hearing/Speech Impaired

Improvements suggested:

- provide signs on arrival level for COMMUNI-CAID
- centre should be open 24 hours a day
- COMMUNI-CAID should display PA announcements on the monitor

Positive aspects:

- system easy to use
- TDD in airport a welcome sight
- user friendly

Sight Impaired

Improvements suggested:

- audio mode not clear when noise level in the airport is high
- difficult to understand connection between main monitor and flight monitor
- response/delay of audio system seem to be inconsistent
- dog is trained to follow boundary lines, so COMMUNI-CAID instruction is inappropriate

Positive aspects:

- enlarged keyboards very good idea
- explanations for directions clear and simple
- good to have a place for seeing-eye dog

Wheelchair and Motor Impaired

Improvements suggested:

- desk too high for wheelchair
- steeper slope for the desk
- how to move the cursor?
- change from one language to the other must be faster
- provide print-outs of flight schedules

Positive aspects:

- easy-to-use push buttons
- information on airport facilities, e.g., elevators, excellent
- print-out is a good way to get through the airport

Association Representative (Deaf Association)

- publicity for such a system is extremely important
- system very useful
- a necessary option for the deaf community; many travel often
- service should be open 24 hours a day in the airport

Changes and Implementations after Phase II

The following is a list of design and hardware changes. Software changes were made by CSTR in Victoria. A separate report describes this part and is shown as Appendix E.

1. Local telephone set was removed from the wall inside COMMUNI-CAID and placed on the table surface near the visual ear.

2. Couplings of visual ear were improved to prevent random sounds from sending signals.

3. Operation of the phone and visual ear was enhanced by colour-coding their respective component parts.

4. Hand phone for audio mode replaced by earphones.

5. Task light installed to illuminate print-out.

6. Digital clock replaced by one with stronger contrast between numbers and background.

7. Two transparent but sturdy gates were built at each entrance, with locks to secure the station when not in use.

8. Walkman-type earphones replaced by head phones with volume controls.

9. A cover for the table keyboard was built, with push buttons on top of the cover, closer to the user.

10. Arrangement of the push buttons was changed to a diamond shape, relating actual location with desired direction; e.g., "up" button in the upper location, "left" button on the left.

6.1.3 PHASE III

Problems encountered by operators, listed in order of frequency:

1. Keyboard lacks "erase" key for corrections
2. Difficult to know when the print-out has arrived at the tray
3. Many users do not read the instructions before using the system, therefore confusion about push button and keyboard functions

Other comments made by users:

Hearing Impaired

Improvement suggestions:

- visual ear quality not very good
- difficult to read screen (black letters/white background)
- should have paging mode for a hearing partner in the airport

Positive aspects:

- good system; there should be more in other terminals
- dialogue easy to complete with operators
- TDD device indispensable in the airport
- table keyboard easy to use because it is similar to those used in offices
- COMMUNI-CAID dialogue exceedingly useful to express concerns
- COMMUNI-CAID effective and easy to use; unfortunate it must close down after EXPO 86
- COMMUNI-CAID very useful for someone strained in the airport

Sight Impaired

Improvement suggestions:

- flight monitor letters should be as enlarged like the keyboard letters
- choice of language should be clearer
- audio and visual introduction do not run simultaneously

Positive aspects:

- no difficulties choosing language
- headset a good solution to block out terminal noise
- instructions and information clear, easy to find restaurants
- difficult to read keywords from 40 cm distance, but highly visible from 15 cm
- easy to get into the audio system
- impressive information and speed
- audio program easy to use

Wheelchair and Motor Impaired

Improvement suggestions:

- sometimes too long to get the right answer (4 menus)
- not clear how to move the cursor
- difficulty finding the print tray
- include list of car agencies with automobiles equipped with hand controls
- keys too close together on the table keyboard
- not clear how to work the flight monitor
- maps require more "landmarks"

Positive aspects:

- no difficulty getting started using the system and following instructions
- push buttons easy to reach and to operate
- fun to see how cursor reacts to choices
- most important information in the system-transportation to city and hotels
- travelling could be done more independently with COMMUNI-CAID at all major airports

- great device for anybody travelling
- information about airport facilities and ground transportation very useful
- computers usually intimidate, but not COMMUNI-CAID
- very user-friendly
- ticket purchase should be included
- COMMUNI-CAID and visual ear "great" for calling friends locally to arrange to be picked up at airport
- ideal for one who does not know airport well

7.0 BENEFITS OF COMMUNI-CAID

The development and demonstration resulted in significant benefits to the following:

1. Hearing and speech impaired travellers

2. Sight impaired travellers

3. Elderly travellers

4. Motor impaired and wheelchair travellers

5. General public

6. Airlines

7. Airport facilities

1. Hearing and Speech Impaired

COMMUNI-CAID provided the hearing and speech impaired the opportunity to access information in a concentrated form. Dialogue through computer decreased embarrassing identification procedures and increased their independence to try travelling alone. The position of a TDD device (visual ear) was also welcomed as the only means available in an airport for outside communication.

2. Sight Impaired

For the blind, being able to retrieve information via a synthesized voice was a great advantage. For the sight impaired, the amplified keywords on the monitor accompanying the voice were very effective for reinforcement of information.

3. Elderly

For the elderly traveller, COMMUNI-CAID provided a relatively private means to access information at their own pace. Travellers with arthritis and rheumatism welcomed the large push buttons, the choice between visual and audio modes, and a place to sit while retrieving information.

4. Motor Impaired and Wheelchair Users

COMMUNI-CAID offers the motor impaired a set of controls that are easy to operate because of their large size and wide spacing. At the same time, they can rest their arm on the inclined table.

Although wheelchair users usually have no problem retrieving information, except when they are motor impaired, they do face mobility problems related to information. For example, in not knowing where the nearest washroom is, a lot of energy can be wasted.

5. General Public

A great number of the general travelling public benefited from this central information point in the airport, where flight schedules from all carriers were displayed on one monitor at the touch of a button.

COMMUNI-CAID also seemed to sensitize the general public to the problems of communication impaired people. Audio and visual reinforcement of information was seen as a great advantage to everyone.

6. Airlines

Although no specific data could be obtained from the carriers, it is not difficult to see how this information system can ease the workload for the agent when confronted with sensory impaired travellers with no means of communication except gestures and facial expressions. Cost savings can be substantial if the need to provide a free seat for the companion can be eliminated.

7. Airport Facilities

Effective dissemination of essential information to the traveller is an important objective of any airport. Since the needs of the sensory impaired have been served only marginally in the airports - such as low access telephones with sound amplification - COMMUNI-CAID provided a concentration of information accessible by many types of impaired travellers. This facility could result in increased travel by this target group.

8.0 CONCLUSIONS

The overall conclusions of the evaluation were that:

1. The prototype was operating successfully
2. The users responded positively
3. The design of this centre should be further simplified
4. Additional development work is required to satisfy all the needs of the users and the operational requirements of the airport terminal

1. The prototytpe was operating successfully

During the eleven months of operation of the prototype at Vancouver International Airport, COMMUNI-CAID operated successfully without any breakdown of any of the technical components. Only once after eight months did the jet printer and CPU have to be cleaned because dust had accumulated.

No misuse or vandalism was reported. This was probably due to two factors: (1) the presence of operator(s) (2) the location of COMMUNI-CAID near the Transport Canada Information booth, where staff was present 22 hours a day and kept an eye on the prototype. In terminals where these conditions cannot be met, such equipment has to be designed and built to provide more protection.

2. The users responded positively to this new application of technology

The comments by users and observations by operators showed an enthusiastic endorsement of the COMMUNI-CAID concept. This is further enforced by letters received and publications in the press, which are included in Appendix C.

Although critical comments were made about details and improvements were suggested, not one negative comment was made regarding the concept for such a communication centre using high technology.

The test run of COMMUNI-CAID also indicated the need to combine the access to such essential information for both the sensory impaired and the general public. The attractive design of the centre and the components revealed that complex technology can be brought successfully to the user through the application of human factors; that is, the relationship of physical and psychological factors between the user and the product.

3. The design of this centre should be further simplified

Many improvements can now result from this demonstration, especially in the reduction and simplification of input controls, the enhancement for voice and voice control, the physical size of the centre, the elimination of a human operator, the use of one monitor only, and the design of visual menus with contrast control.

Combined with the access for the general public, it could present one desirable common information point for all at different levels of the terminal, fed by one database.

4. Additional development work is required to satisfy the needs of the users and terminal operation

The objective of this project phase was to create a relationship between sensory impaired travellers and advanced technology. It can safely be said that this goal was achieved.

The next phase must be twofold: (1) to address the modifications required to improve this interface (2) to analyze and design a system for the effective implementation and operation in terminals.

Combined with a general public information system, it will make terminals more information accessible and contribute to increase independent travel of the sensory and motor impaired population.

9.0 RECOMMENDATIONS

This design and development process has to be viewed in perspective; that is, as a first step toward transforming a list of ideal requirements into a three-dimensional product. This results usually - and this project is no exception - in a product which attempts to achieve too many things at once, thus being able to address only some to a certain degree. Only with the feedback, advice, cooperation, and foresight of all people involved is it possible to take the next important step which consists of a process of elimination and priorization, with a view to producing and implementing this unique product.

As a result of the demonstration and use of COMMUNI-CAID, recommendations can be made for the development of an improved communication centre. These recommendations result from test data suggestions and advice received from all participants in the development of the first prototype. They are as follows:

1. The information centre should be independent, eliminating the need for an operator.
2. It should be smaller and more compact, with a reduced number of controls.
3. It should be accessible to sensory impaired travellers as well as the general public.

4. It should have a single monitor with contrast control.
5. It should have a sound hood with stereo effect and volume control.
6. It should have all airline scheduling on one monitor only.
7. It should have a built-in chair.

Although these recommendations suggest eliminating the need for an operator/agent, one cannot eliminate the need for dialogue.

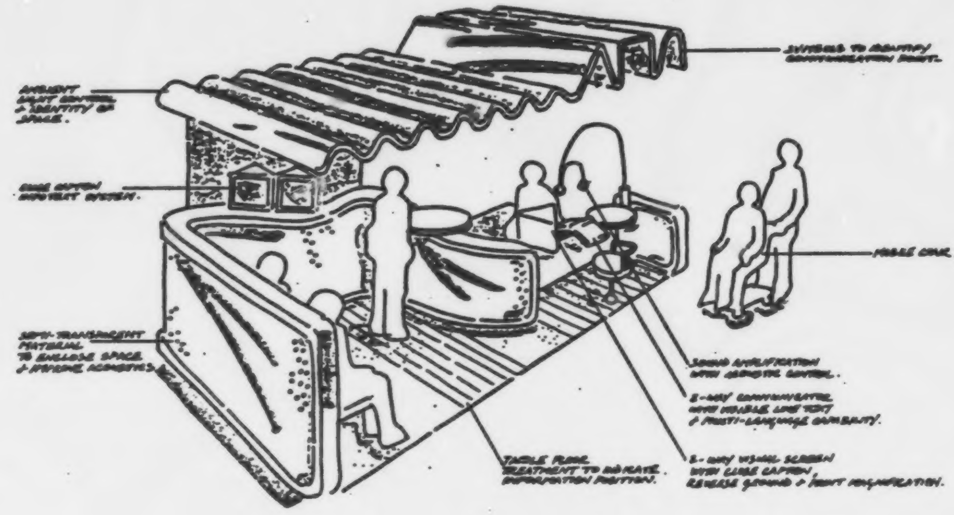
The need is actually increasing today by the amount of travellers who do not speak English or French.

It is therefore recommended to design a MOBILE COMMUNICATOR/TRANSLATOR which can be placed directly at the airline counter and provide:

1. Basic dialogue essential for communication between the agent and the traveller for seat selection, gate location, document exchange, flight delayes, flight changes, etc.
2. Simultaneous visual and audio modes, such as written text and sound.
3. Input by the traveller in 4-6 languages, with translation into English or French on the agent's side.
4. Input by the agent in English or French with traveller's chosen language on his/her side.

APPENDIX A

PHOTOGRAPHS AND FIGURES


AMBIENT LIGHT CONTROL & IDENTITY OF SPACE.
CLOSE CAPTION MONITOR SYSTEM.
SEMI-TRANSPARENT MATERIAL TO ENCLOSE SPACE & IMPROVE ACOUSTICS.
SYMBOLS TO IDENTIFY COMMUNICATION POINT.
MOBILE CHAIR.
SOUND AMPLIFICATION WITH ACOUSTIC CONTROL.
2-WAY COMMUNICATOR WITH VISIBLE LINE TEXT & MULTI-LANGUAGE CAPABILITY.
2-WAY VISUAL SCREEN WITH CLOSE CAPTION, REVERSE GROUND & FONT MAGNIFICATION.
TACTILE FLOOR TREATMENT TO INDICATE INFORMATION POSITION.

Communication Centre

DESIGN COPYRIGHT
RATENBERG DESIGN INC.
MONTREAL, NOV. 29, 1984.

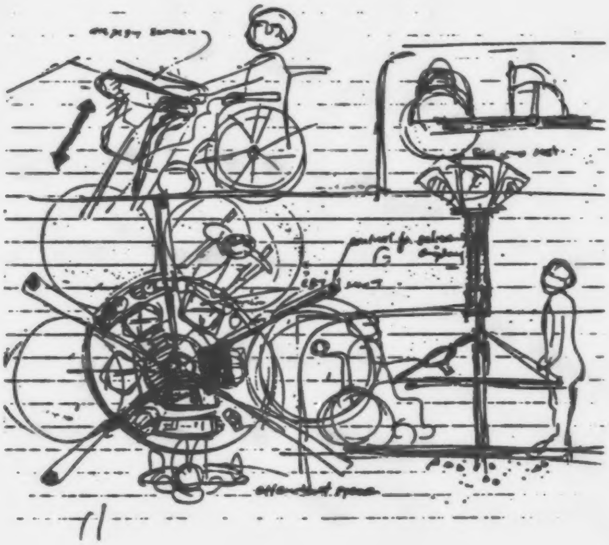

display screen
G
attendant space

Fig. 1 Design sketches of first approach

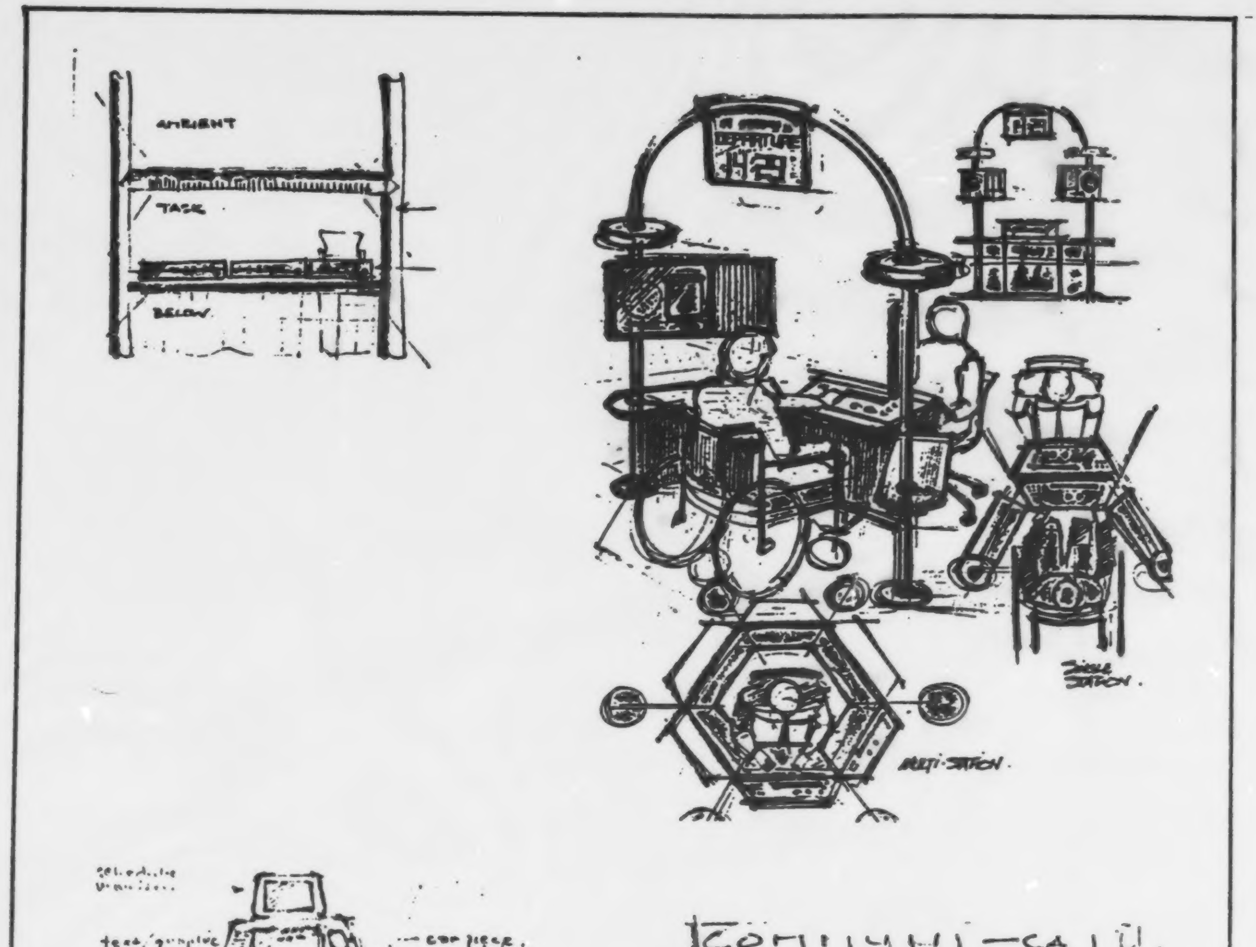

AMBIENT
TASK
BELOW
DEPARTURE
14:29
SINGLE STATION.
MULTI-STATION.
schedule monitor
text/graphic monitor
ear piece.
cpu
phone
working area.
station
ear piece
COMMUNI-CAID.
operator
user
cpu
screen motor
arm
arm
power tube.

Fig. 2 Design sketches of second approach

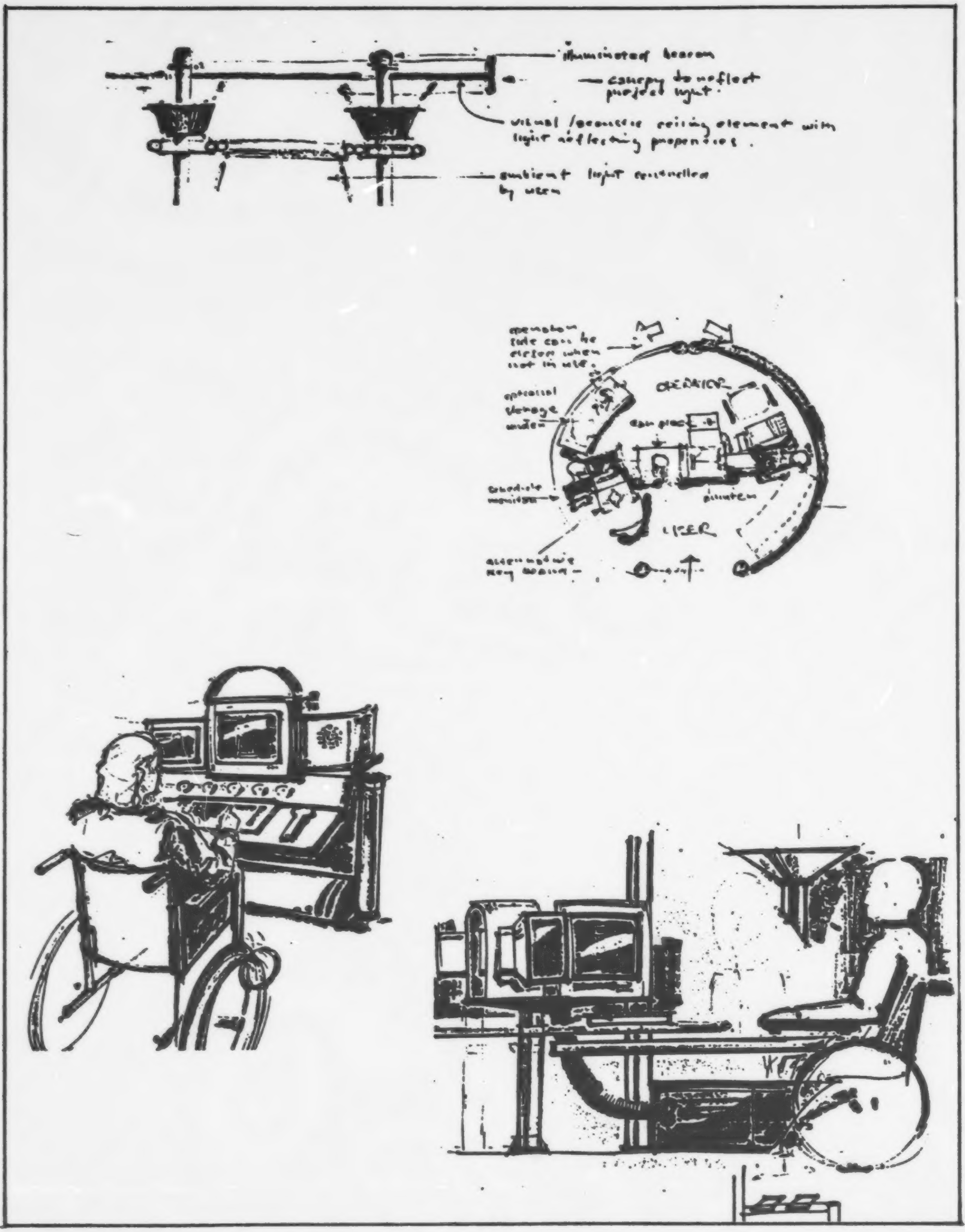

illuminated beam
canopy to reflect projected light.
visual/acoustic ceiling element with light reflecting properties.
ambient light controlled by user
operator side can be closed when not in use.
optical storage units
OPERATOR
computer
graphic monitor
printer
USER
alternative key board

Fig. 3 Design sketches for final approach

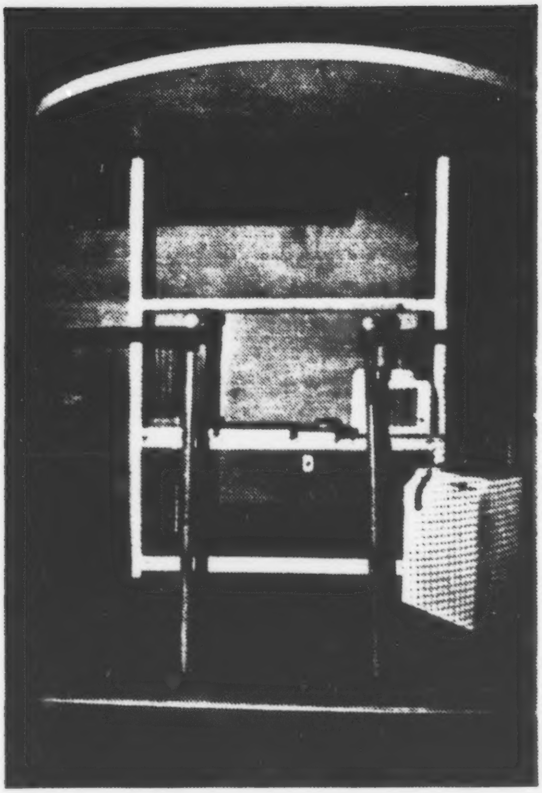


Fig. 4

Preliminary mock-up of final approach

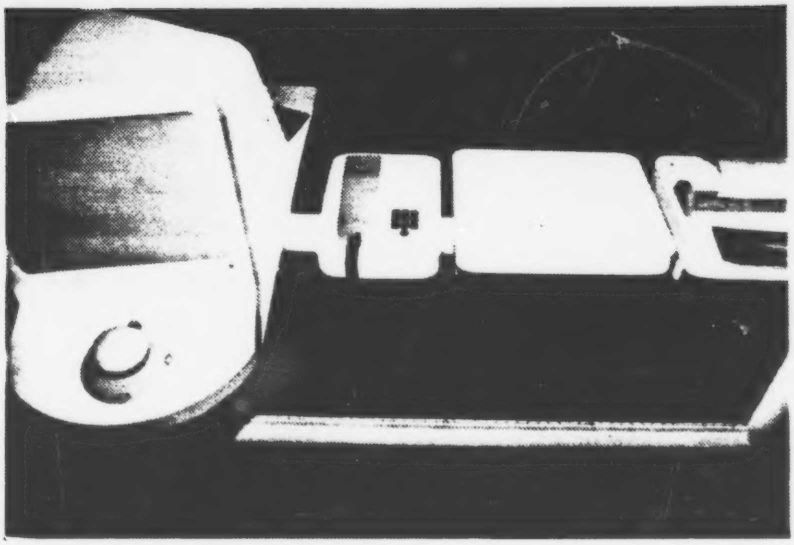


Fig. 5

Traveller's side: simulated monitor with joystick, phone, writing surface and printer

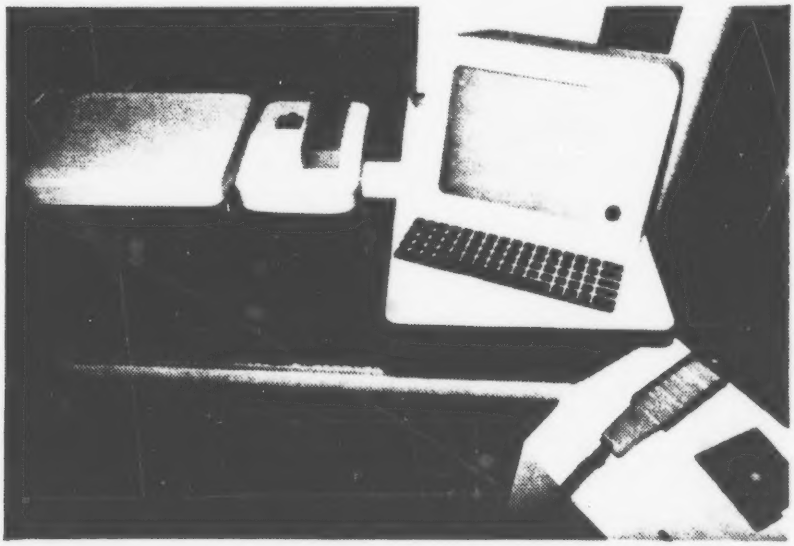


Fig. 6

Operator's side: simulated monitor with keyboard, phone and database

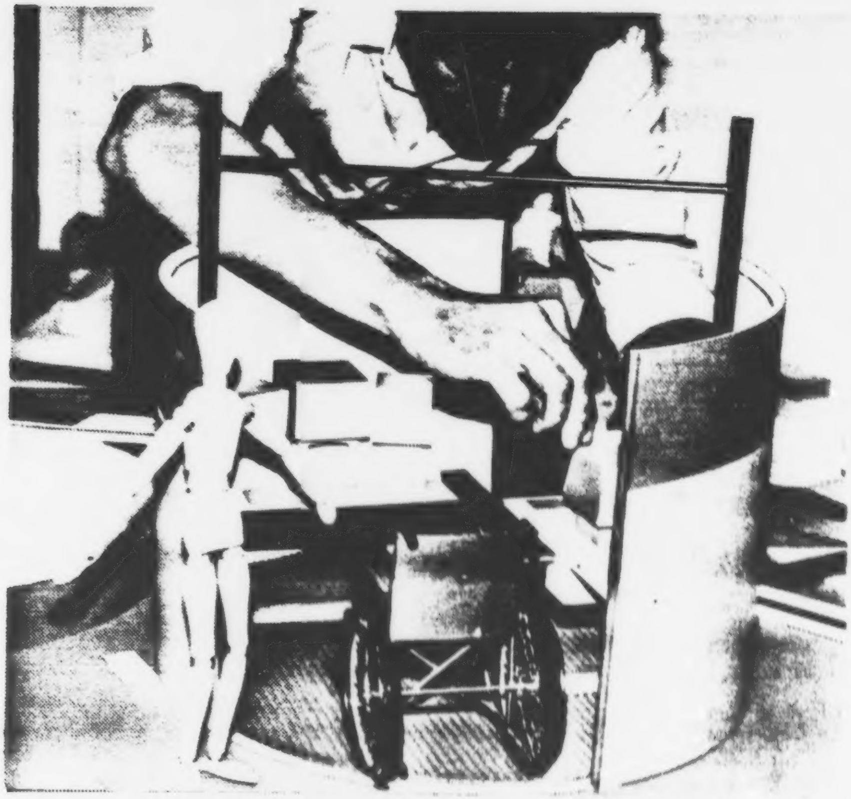


Fig. 7
Refined final approach in model form

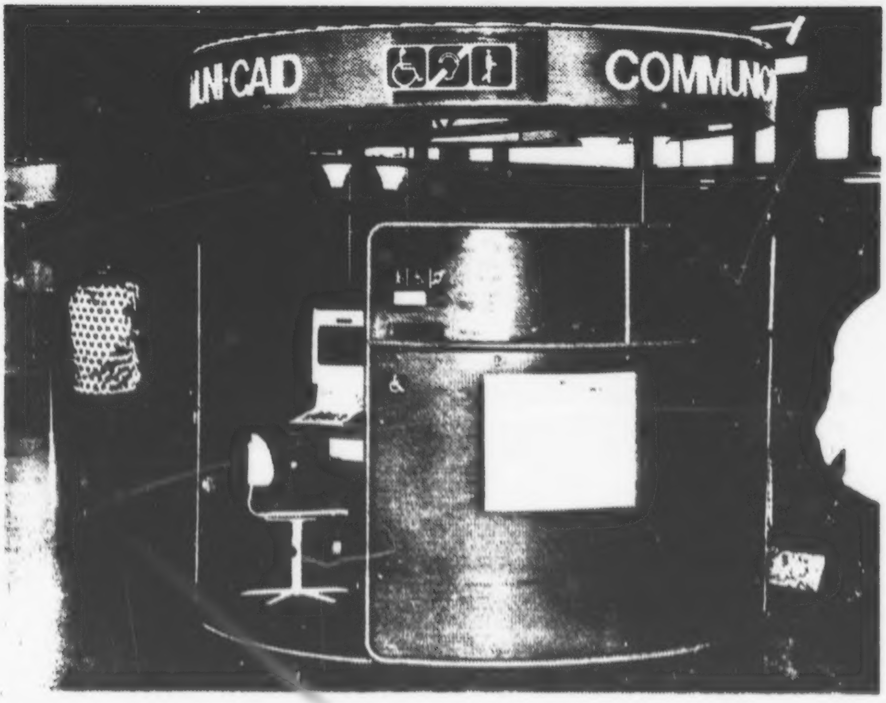

UNI-CAID
COMMUNI

Fig. 8
COMMUNI-CAID prototype with large international symbols for sensory impaired travellers in operation at Vancouver International Airport

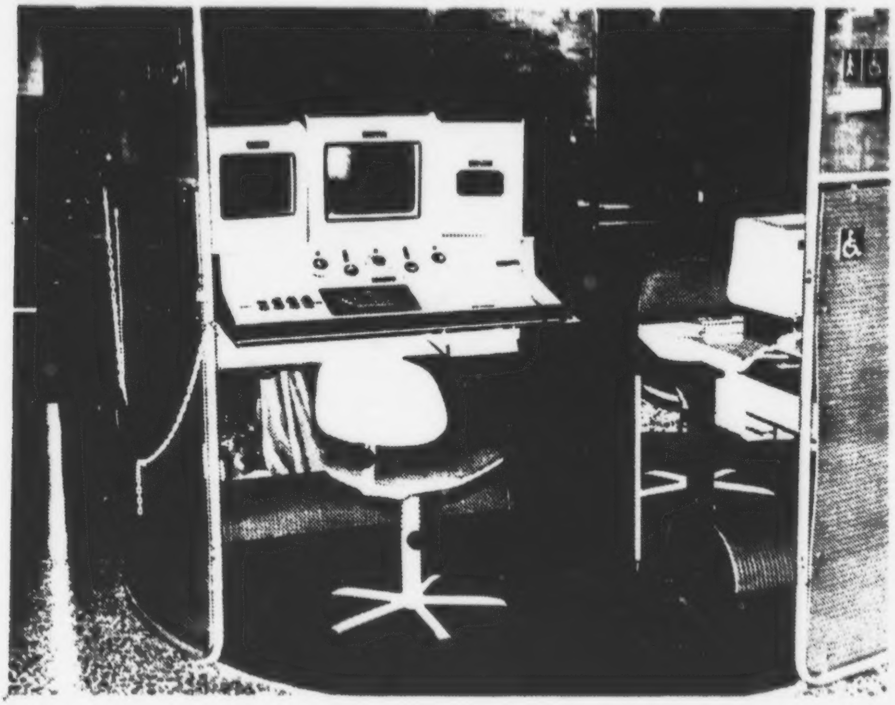


Fig. 9
Traveller's entrance with central display area, adjustable chair and symbols for sensory impaired at eye level

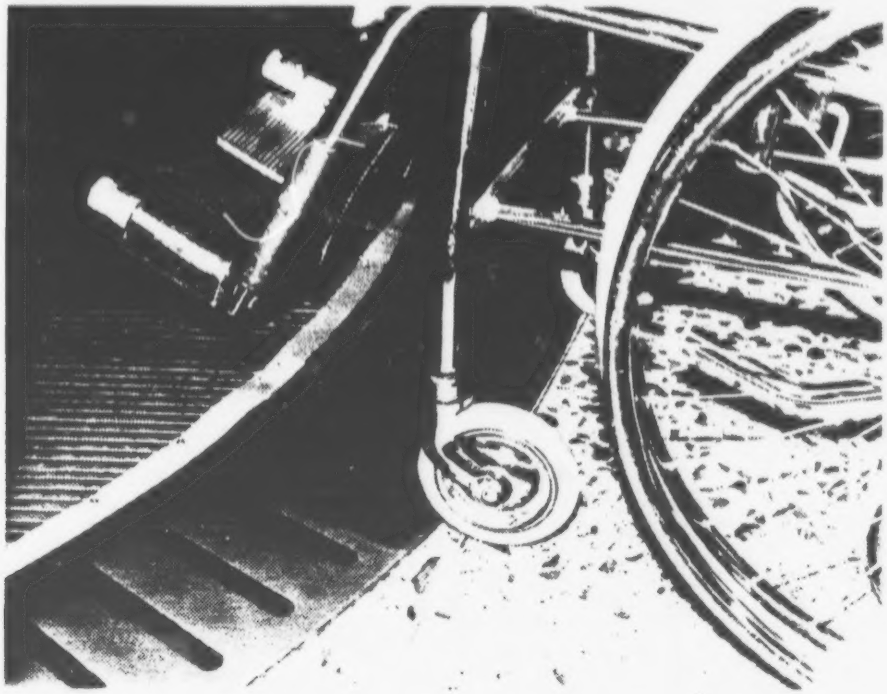


Fig. 10 Wheelchair ramp at entrance

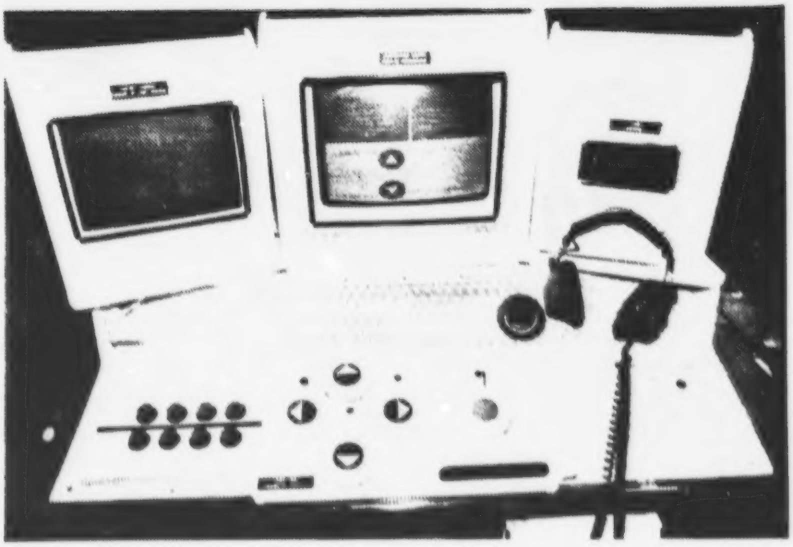


Fig. 11

Information display area with monitors,
large push buttons, flight monitor control, headset
and volume control

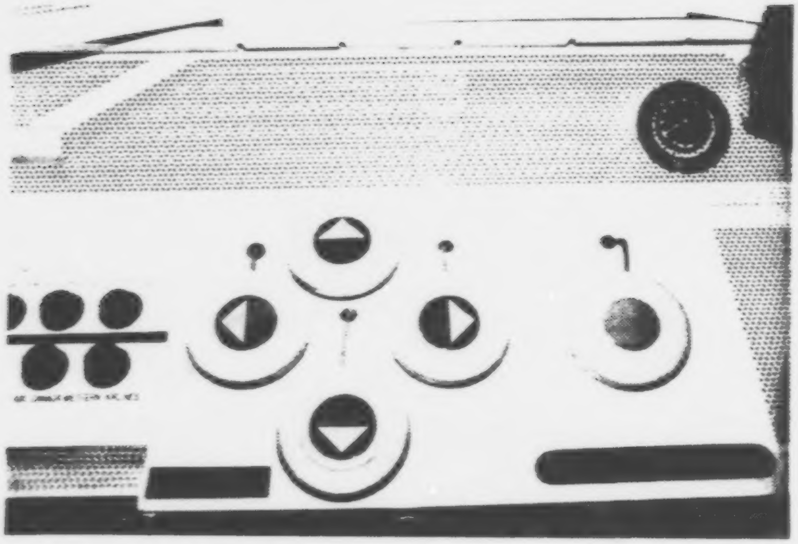


Fig. 12
Access controls

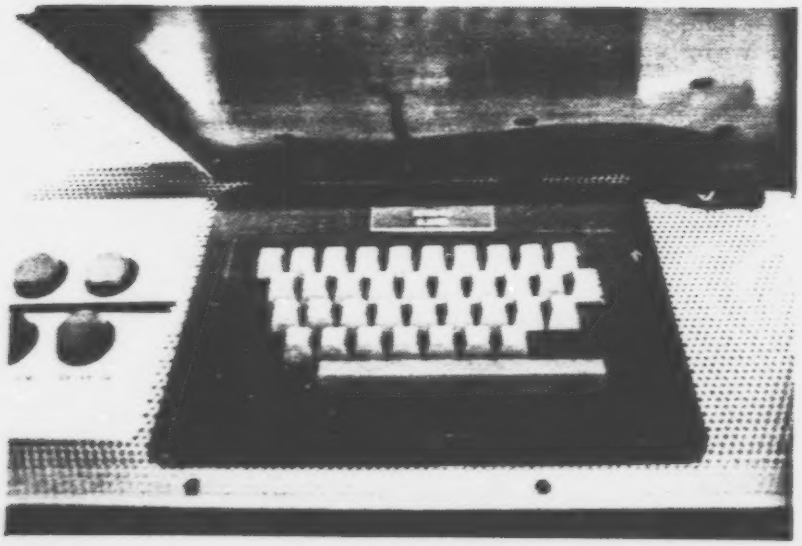


Fig. 13
Keyboard under control panel

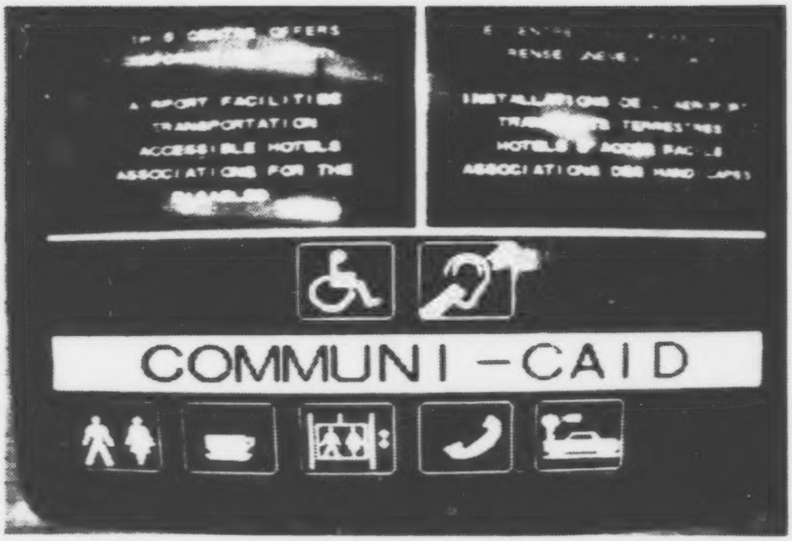
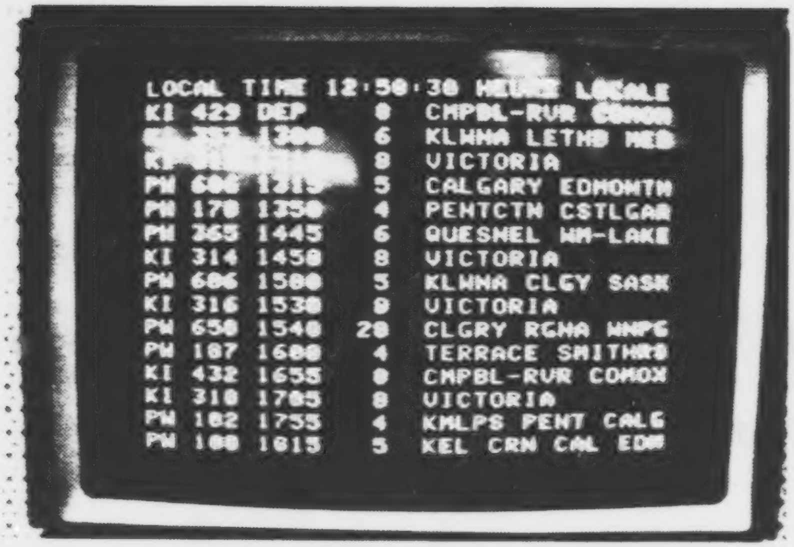

TRANSPORTATION
ACCESSIBLE HOTELS
ASSOCIATIONS FOR THE
ASSOCIATIONS
COMMUNI-CAID

Fig. 14

Final modified visual introduction menu



```
LOCAL TIME 12:50:30 HEURE LOCALE
KI 429 DEP    8  CMPBL-RVR COMOX
[illegible] 1300   6  KLWNA LETHB MED
KI [illegible]     8  VICTORIA
PW 606 1315   5  CALGARY EDMONTN
PW 170 1350   4  PENTCTN CSTLGAR
PW 365 1445   6  QUESNEL WM-LAKE
KI 314 1450   8  VICTORIA
PW 606 1500   5  KLWNA CLGY SASK
KI 316 1530   8  VICTORIA
PW 650 1540  20  CLGRY RGNA WNPG
PW 187 1600   4  TERRACE SMITHRS
KI 432 1655   8  CMPBL-RVR COMOX
KI 310 1705   8  VICTORIA
PW 102 1755   4  KMLPS PENT CALG
PW 100 1815   5  KEL CRN CAL EDM
```

Fig. 15
Flight monitor displaying schedules of all airlines on one screen

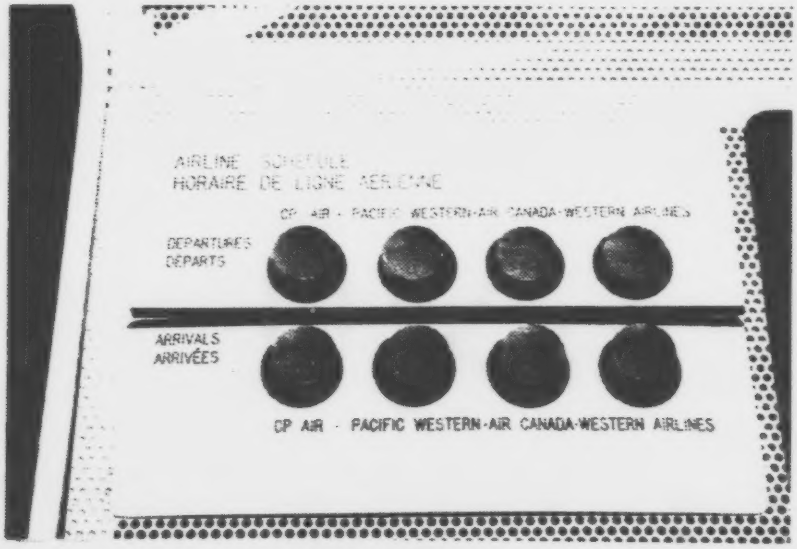

AIRLINE SCHEDULE
HORAIRE DE LIGNE AERIENNE
CP AIR - PACIFIC WESTERN-AIR CANADA-WESTERN AIRLINES
DEPARTURES
DEPARTS
ARRIVALS
ARRIVÉES
CP AIR - PACIFIC WESTERN-AIR CANADA-WESTERN AIRLINES

Fig. 16
Flight monitor controls

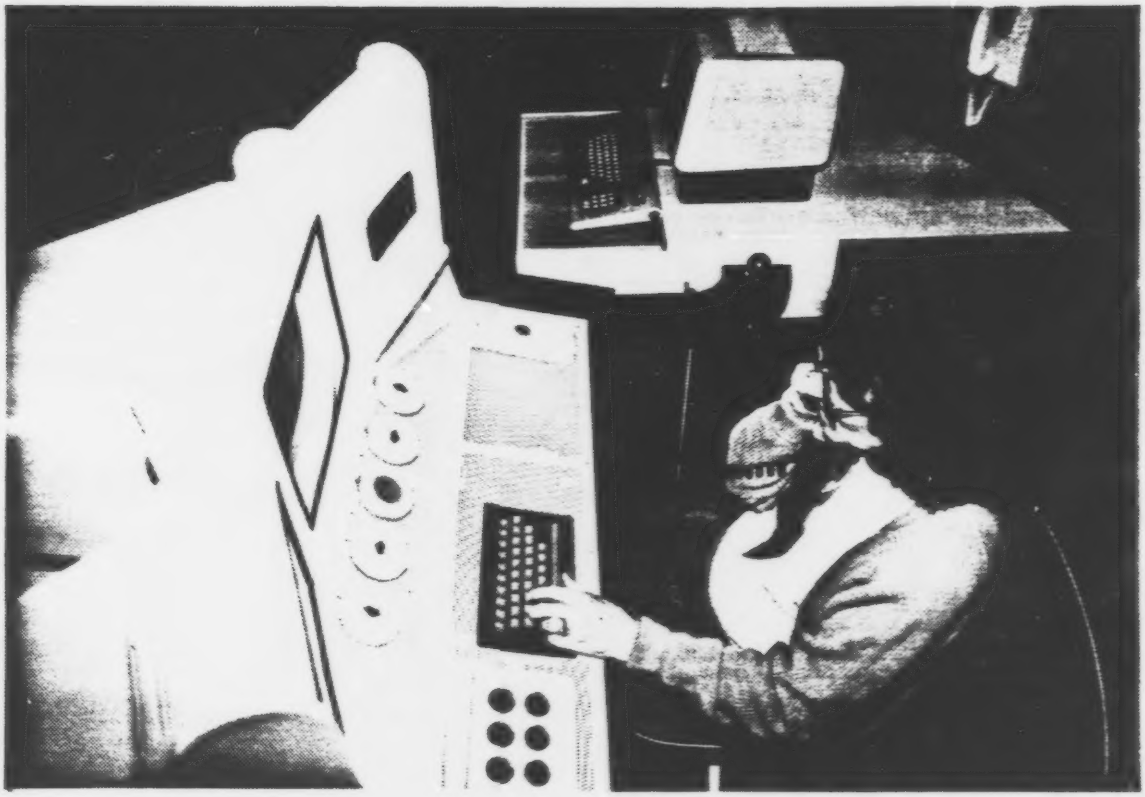


Fig. 17
Use of audio mode without an operator

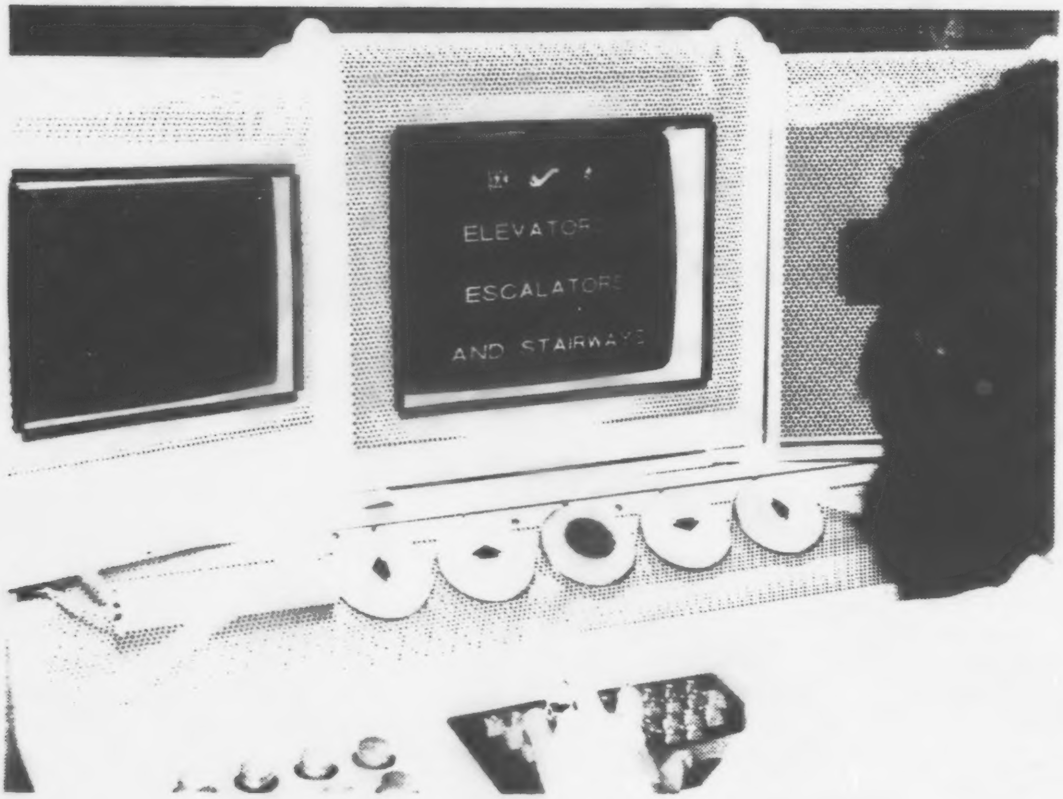

ELEVATORS
ESCALATORS
AND STAIRWAYS

Fig. 18

Simultaneously displayed enlarged keywords for lesser sight impaired when using audio mode

Fig. 19
Computer aided dialogue between impaired traveller and operator

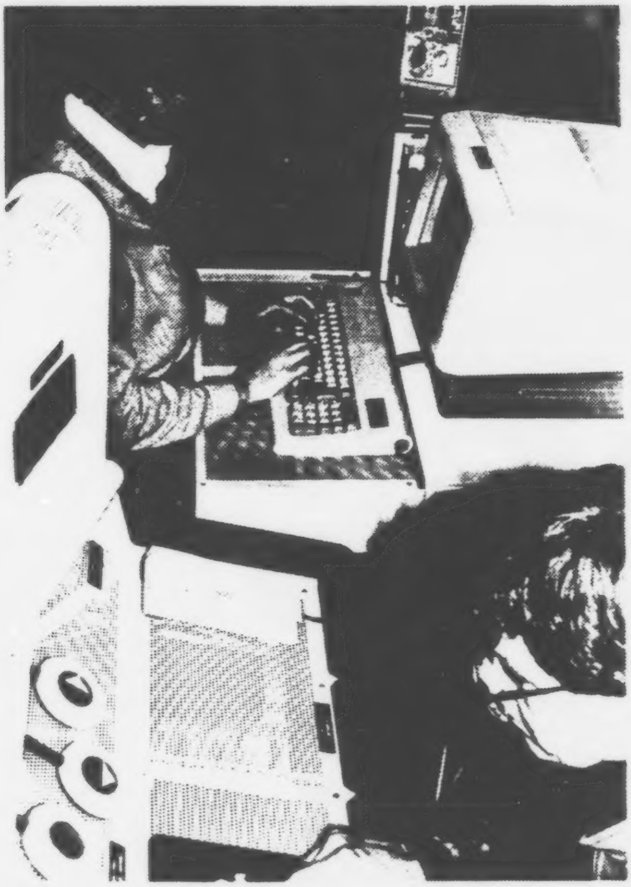


Fig. 20
Operator assisting in communication with airline

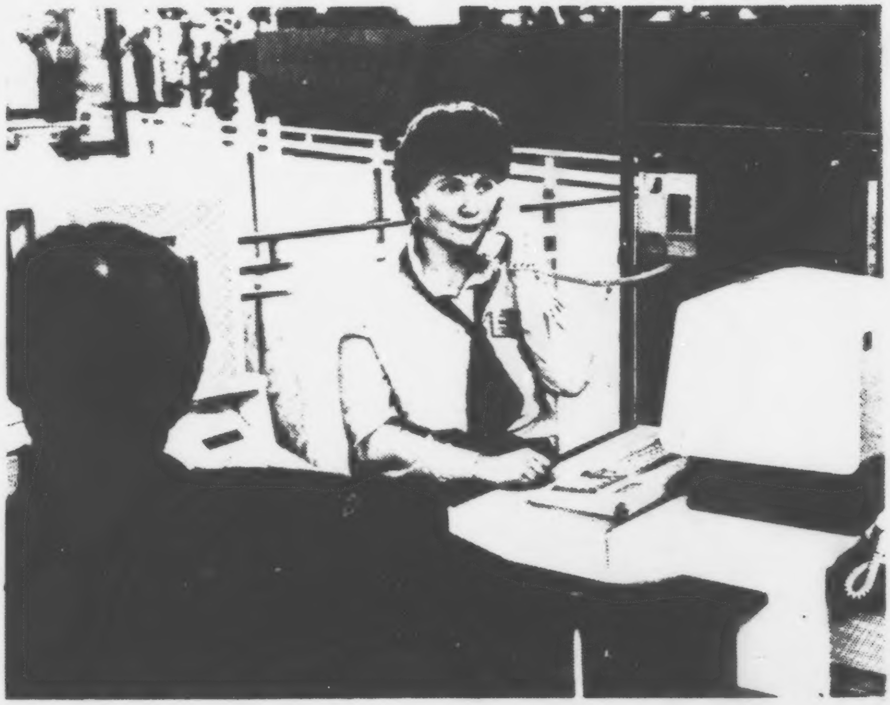


Fig. 21

Laser printed map of airport with location of facilities

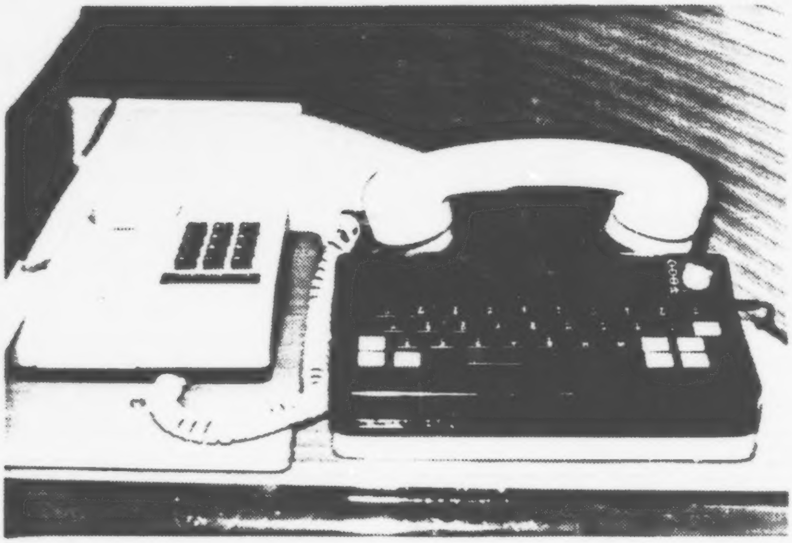


Fig. 22 Location of TDD (visual ear)

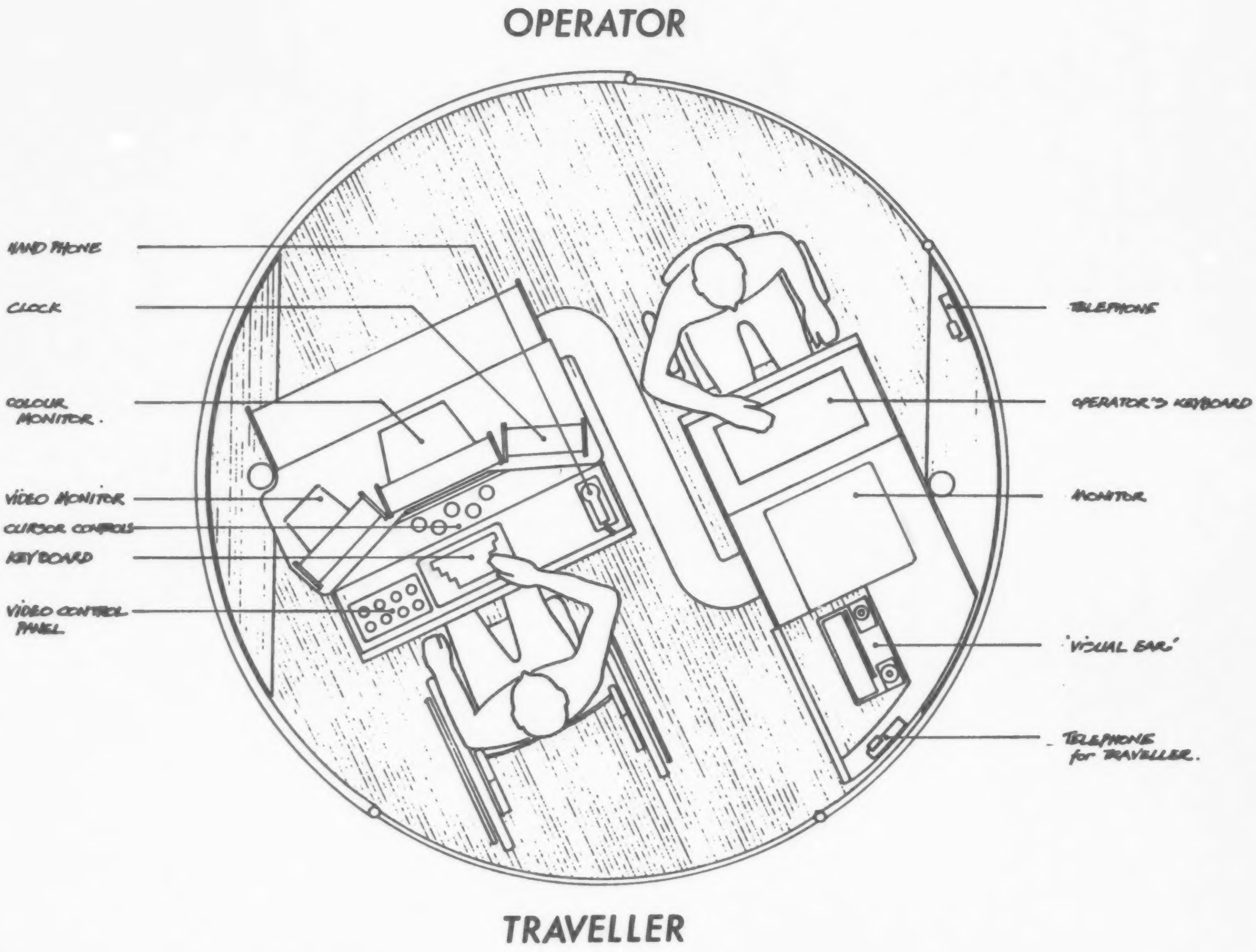
The TDD is located near local phone on traveller's side

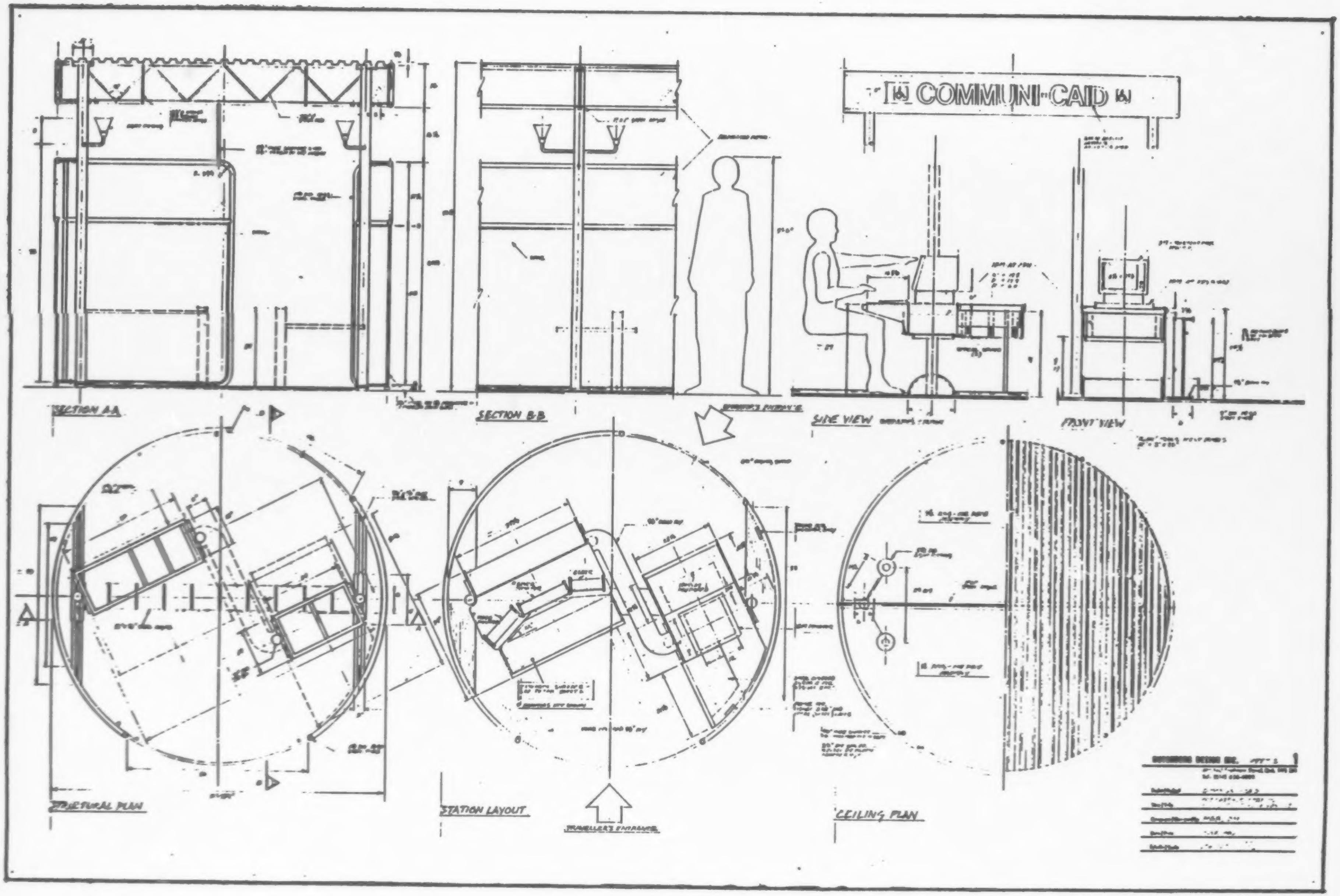
Fig. 23 Gates

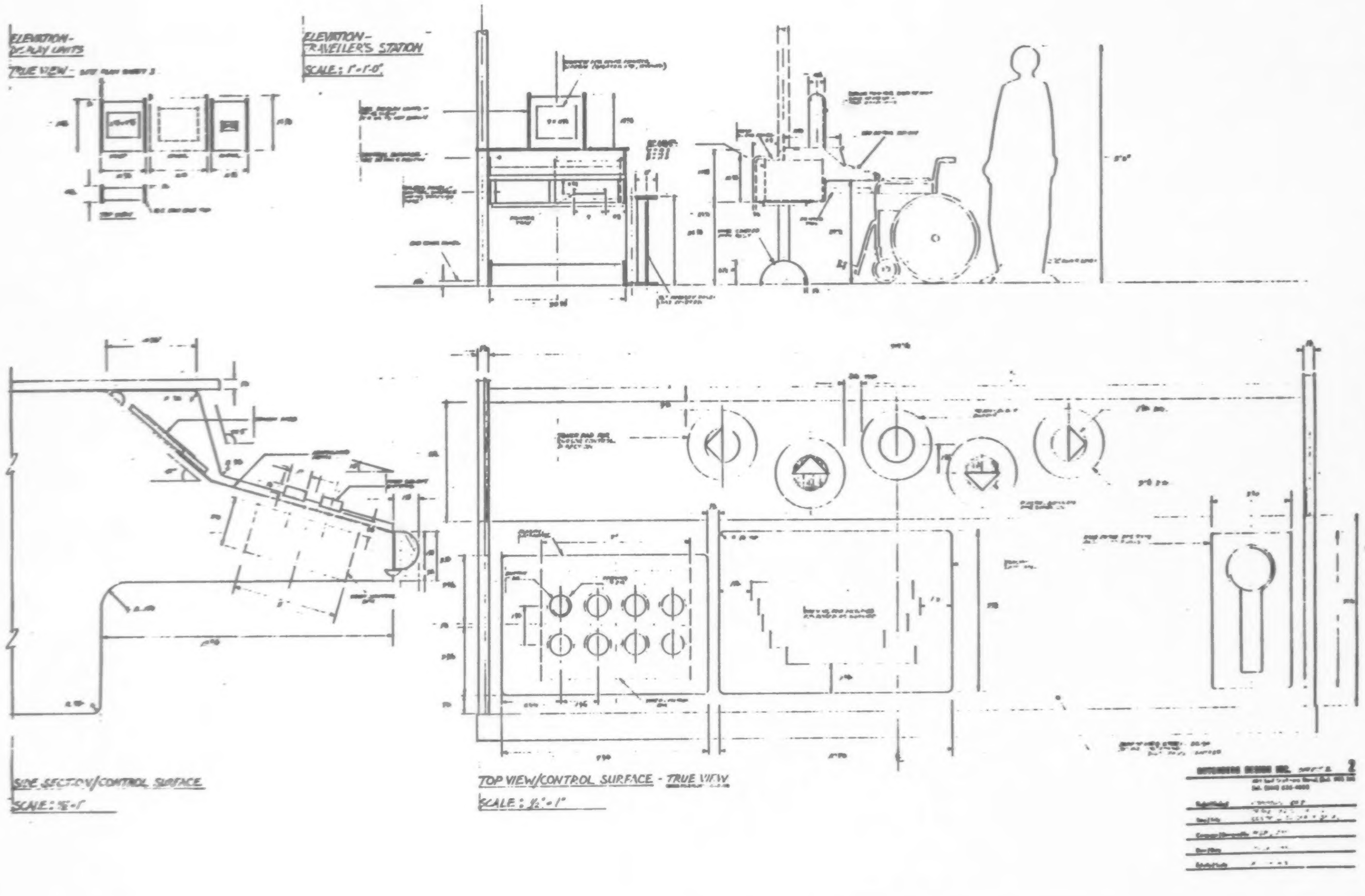
Transparent gates to lock centre while not attended by operator

APPENDIX B

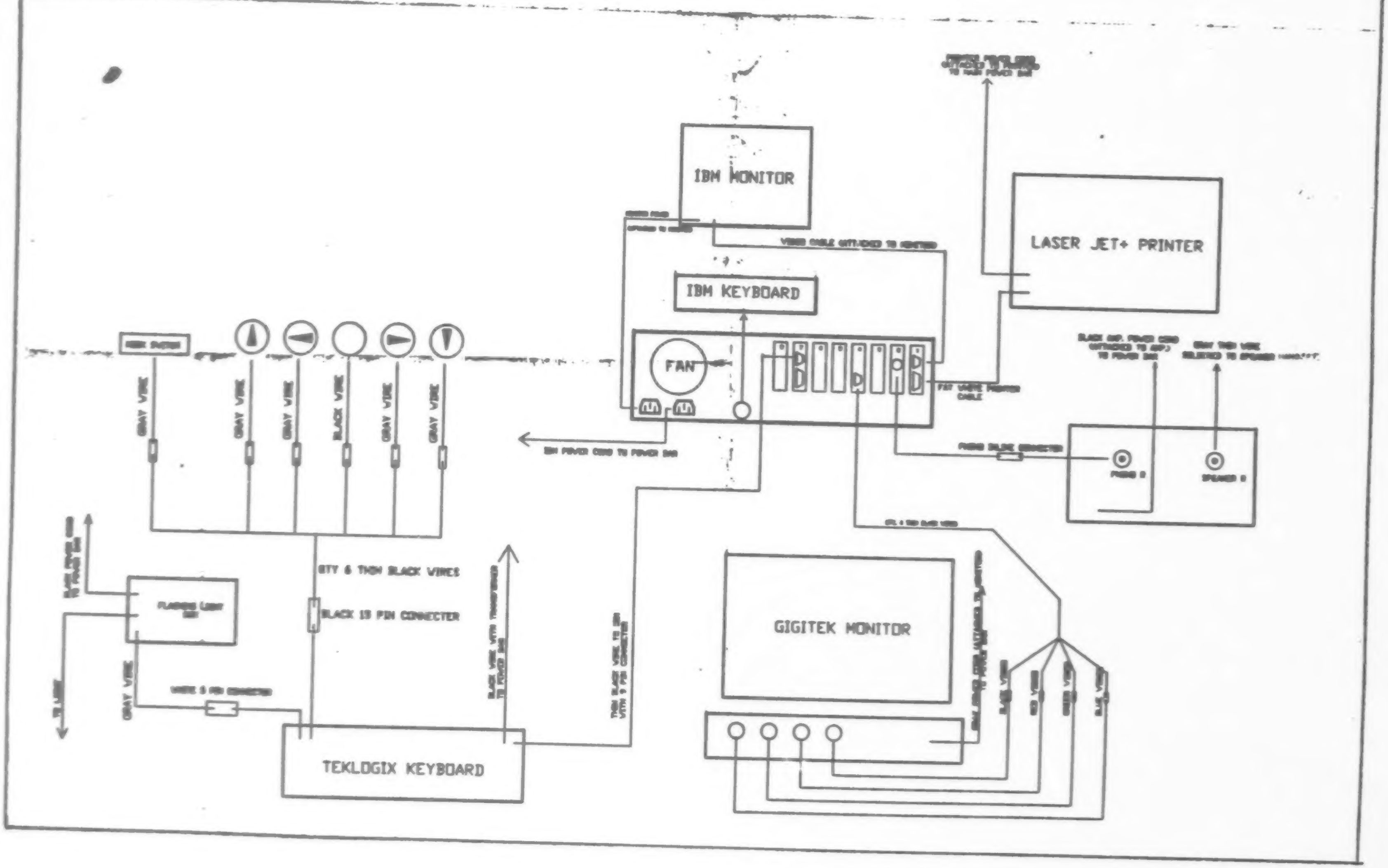
PRELIMINARY DRAWINGS, WIRING, AND DATA FLOW DIAGRAM


OPERATOR
HAND PHONE
CLOCK
COLOUR MONITOR.
VIDEO MONITOR
CURSOR CONTROLS
KEYBOARD
VIDEO CONTROL PANEL
TELEPHONE
OPERATOR'S KEYBOARD
MONITOR
'VISUAL EAR'
TELEPHONE for TRAVELLER.
TRAVELLER


COMMUNI-CAID
SECTION A.A
SECTION B.B
SIDE VIEW
FRONT VIEW
STRUCTURAL PLAN
STATION LAYOUT
TRAVELLER'S ENTRANCE
CEILING PLAN


ELEVATION - DISPLAY UNITS
TRUE VIEW -
ELEVATION - TRAVELLER'S STATION
SCALE: 1" = 1'-0"
SIDE SECTION/CONTROL SURFACE
SCALE: ⅜" = 1'
TOP VIEW/CONTROL SURFACE - TRUE VIEW
SCALE: ½" = 1'
2

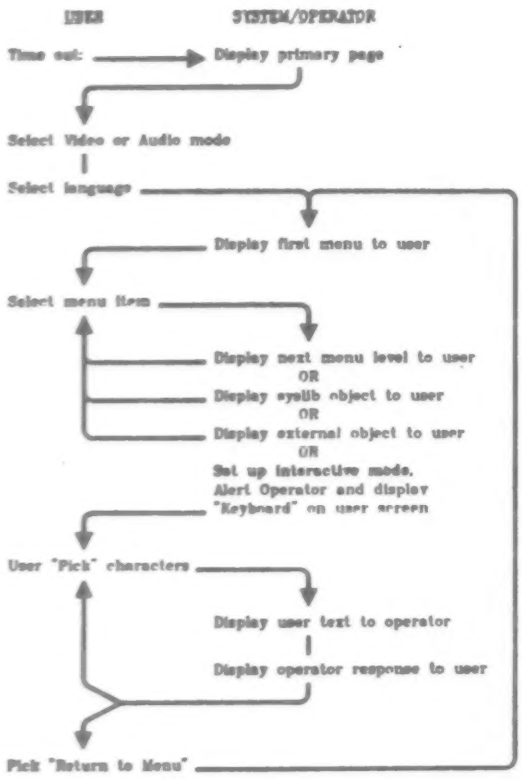
COMMUNI — CAID
WIRING DIAGRAM


IBM MONITOR
VIDEO CABLE ATTACHED TO MONITOR
IBM KEYBOARD
FAN
IBM POWER CORD TO POWER BAR
LASER JET+ PRINTER
FAT WHITE PRINTER CABLE
PHONO INLINE CONNECTOR
GRAY VIRE
GRAY VIRE
GRAY VIRE
BLACK VIRE
GRAY VIRE
GRAY VIRE
QTY 6 THIN BLACK VIRES
BLACK 19 PIN CONNECTER
GRAY VIRE
TEKLOGIX KEYBOARD
BLACK VIRE VITH TRANSFORMER TO POWER BAR
THIN BLACK VIRE TO DB9 VITH 9 PIN CONNECTER
GIGITEK MONITOR

QTY	REF	DESCRIPTION	CAT/DWG NO.	ITEM

PARTS LIST

Rutenberg: Principal Data Flows:


USER
SYSTEM/OPERATOR
Time out:
Display primary page
Select Video or Audio mode
Select language
Display first menu to user
Select menu item
Display next menu level to user
OR
Display syslib object to user
OR
Display external object to user
OR
Set up interactive mode.
Alert Operator and display
"Keyboard" on user screen
User "Pick" characters
Display user text to operator
Display operator response to user
Pick "Return to Menu"

Rutenberg: Hardware Elements:

USER	SYSTEM/OPERATOR
15" RGB Monitor	IBM 'AT' Processor
Point & Pick Device (Mouse)	512KB Memory
Audio Transducer (Electrical to Sound Pressure)	1.2MB Floppy Disk
10-Key Touch Tone Pad	20MB Hard Disk
	12" RGB Monitor
	QWERTY Keyboard
	Printer, RGB Colour Cut Sheet

REV	ECO #	DESCRIPTION	DATE	APPROVED

REVISIONS

CROSS REFERENCE NAME	CROSS REFERENCE NUMBER

TEKLOGIX
TLX
MISSISSAUGA
ONTARIO

TITLE

DRAWN BY
APPROVED BY
SCALE
DATE
DATE
SHEET 1 OF 1
DRAWING NUMBER
REV

APPENDIX C

CLIPPINGS AND LETTERS - USER REACTION

CANADIAN PARAPLEGIC ASSOCIATION
BRITISH COLUMBIA DIVISION • HEAD OFFICE 780 S.W MARINE DRIVE. VANCOUVER. B.C. V6P 5Y7
(604) 324-3611

Chairman: Robert F. Moog
Vice-Chairman: Allin H. Moore. M.D.. F.R.C.S.(C.)
Secretary-Treasurer: Donald C. Endacott
Executive Director: Douglas L. Mowat. C.M.

March 23, 1987

Mr. Jack Morgan
Transportation Development Centre
200 Dorchester Blvd.
#601 West Tower
Montreal, Quebec H2Z 1X4

Dear Mr. Morgan:

About a month ago I had the opportunity of using the communication system which is presently at the Vancouver International Airport.

We have also received some very positive feedback from our membership who have also had the opportunity of using the Communicaid. We have found it to be a very high tech communication system which provides instant information for travellers with special needs. I was certainly quite impressed with what it had to offer. There has been a lot of research put into this system and it has a good potential of maintaining Canada's position as a leader in communications technology.

Our Association has placed an article in our newsletter (attached) in order to inform our physically disabled membership that it is available for them to utilize.

We hope the Communicaid system will be maintained at the Vancouver International Airport and expanded to other airports across Canada. This is a very valuable service to the physically disabled.

Once again, we thank you for your efforts to improve information systems for the physically disabled of Canada.

Yours truly,

Norman D. Haw, A.R.W.
Director
Rehabilitation Services

NDH/ba

cc: Mr. D.L. Mowat, C.M. - Executive Director
Canadian Paraplegic Association, BC Division

Mr. U. Ruttenberg - Design Incorporated
130 18E Avenue
Lachine, Quebec

REGIONAL OFFICES

LOWER FRASER VALLEY
Mark Stenberg
780 S W Marine Drive
Vancouver B C
V6P 5Y7
324-3611

NORTH SHORE
SUNSHINE COAST
Wayne Moser
780 S W Marine Drive
Vancouver B C V6P 5Y7
324-3611

VICTORIA/VANCOUVER
ISLAND SOUTH
Samantha Coe
813 Darwin Avenue
Victoria B C V8X 2X7
384-3353

NANAIMO/VANCOUVER
ISLAND NORTH
Peter Hardcastle
683 Montague Road
Nanaimo. B C V9R 3G4
753-3557

SOUTH OKANAGAN
Pius MacInnis
#17-2530 Nechako Drive
Kamloops B C V2E 2C9
828-1324

NORTH OKANAGAN
Pius MacInnis
#17-2530 Nechako Drive
Kamloops B C V2E 2C9
828-1324

KOOTENAYS
Rae Thomas
Box 44
Ymir B C V0G 2K0
357-9373 (Bus)
357-9425 (Res)

NORTHERN
BRITISH COLUMBIA
Al Lachmuth
777 Kinsmen Place
Prince George. B C V2M 6Y7
563-6842

Province of British Columbia

Ministry of Education

OFFICE OF THE PRINCIPAL

Special Education
Jericho Hill Provincial
School for the Deaf
4125 West Eighth Avenue
Vancouver
British Columbia
V6R 1Z7
Phone: 224-1331

March 20th, 1987

Jean Brighouse,
Communi-Caid Centre,
c/o Transport Canada Information
Vancouver International Airport,
Richmond, B.C. V7B 1T6

Dear Ms. Brighouse:

Thank you for your letter and the information enclosed.

This information has been shared with the residential staff involved with travel, to deaf staff and to parents.

In my opinion, this centre is very important and should be continued.

Sincerely,

John L. Anderson

John L. Anderson,
Principal,
JERICHIO HILL SCHOOL FOR THE DEAF

January 29, 1987

Mr. Jack Morgan
Transportation Development Centre
200 Dorchester Blvd. West
Suite 601, West Tower
Montreal, Quebec
H2Z 1X4

Dear Mr. Morgan:

As a frequent (disabled) traveller, I would like to pass on my observations regarding the "Communicaid" centre now operating at the Vancouver International Airport.

In general I've found the "Communicaid" centre to be very helpful. I've found that much of the information available through the system is both practical and useful. I now live in Vancouver and am aware of many resources; were I arriving from another city to an unfamiliar Vancouver, I believe that I would find the information accessed through "Communicaid" to be invaluable.

I've found that the computer and other equipment was accessed fairly easily. The staff person competently answered my questions.

I would like to encourage your department to continue with the development of projects such as "Communicaid". Thank you,

Yours truly,

Lori Bremner

Lori Bremner

cc: Mr. Uwe Rutenburg
Rutenburg Design Inc.
130-18E Ave.
Lachine, Quebec
H8S 3P7

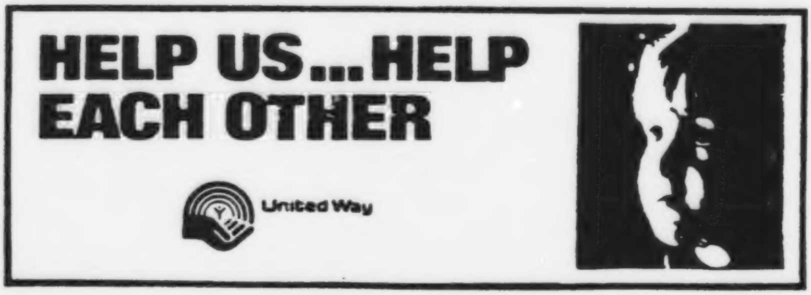
ISLAND BEACON, OCTOBER 1986
WID - Vancouver Island Branch

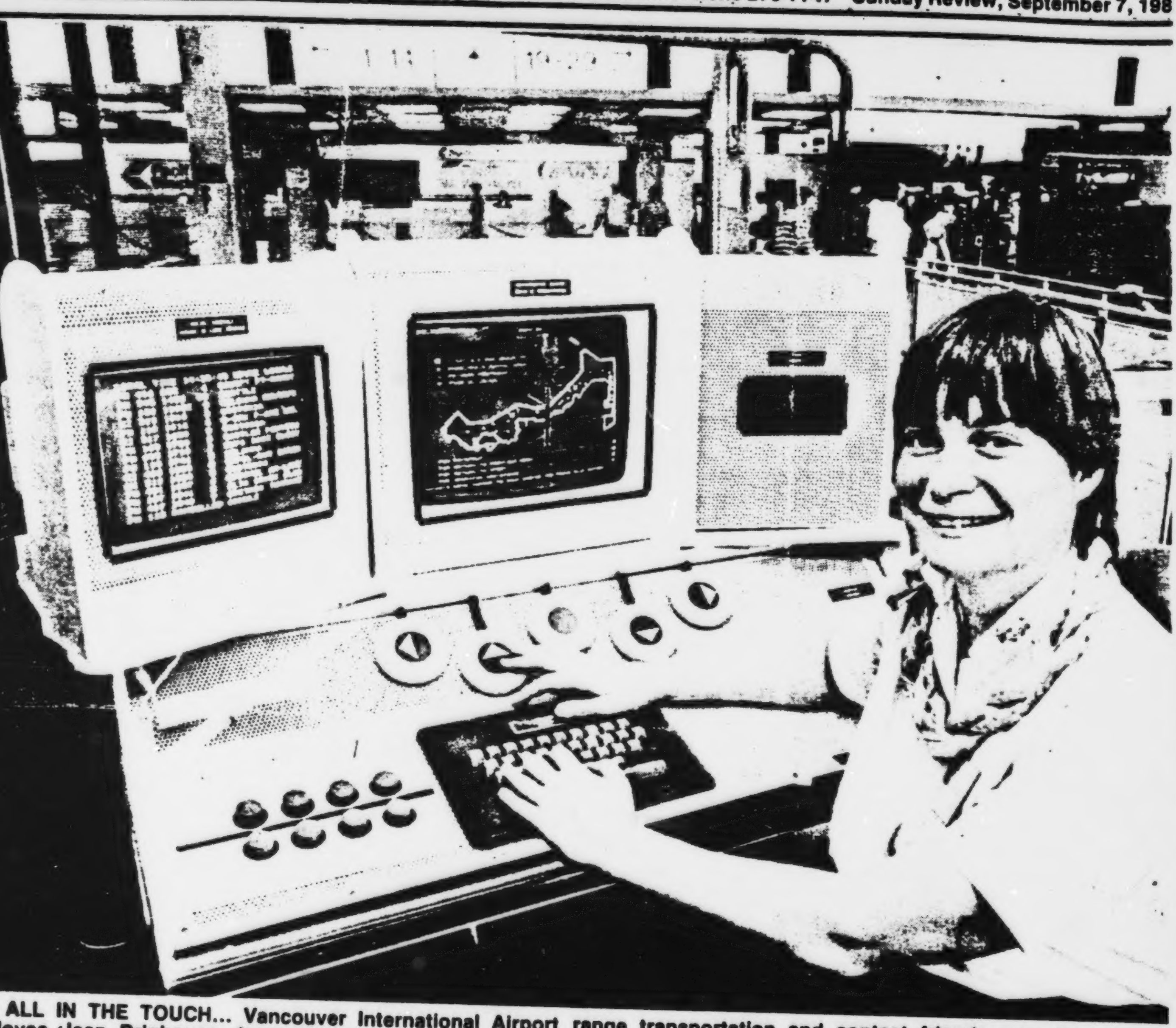
DID YOU KNOW? (continued)

. TRANSPORT CANADA has developed a COMMUNI-CARD to provide information and facilitate communication for hearing impaired travellers. It assists in questions about airport facilities, flight departures and arrivals, ground transportation. INFORMATION can be obtained through a computer and with the help of an operator. To date, this prototype is located by the escalators on level III of the Vancouver International Airport. Have any of you used it/seen it? It was installed mid-June, 1986. Feedback from potential users is important to TRANSPORT CANADA to ensure efficiency and the development of the system. Contact person is: Jean Brighouse at 278-3390

. THE ORDER OF THE ROYAL PURPLE, a women's auxiliary group associated with the Elks Club, have provided a great deal of help to hearing impaired children in the Victoria area over the years. This past summer they provided funding to enable two children to attend summer camp; both of these children had an enjoyable 'skill building' summer. We are grateful and lucky to have an active organization such as the ORDER OF THE ROYAL PURPLE that does so much for hearing impaired and other children in the Victoria community.

. the Victoria Mental Health Center offers workshops for PARENTS OF 2 - 12 YEAR OLD HEARING IMPAIRED CHILDREN. Topics covered are relevant to parents of any child and in addition, during the small group sessions, parents have the opportunity to discuss issues related specifically to raising a child who is hearing impaired. Group leader is LINDA HILL, PhD., who is Counsellor for Hearing Impaired Individuals. Contact Linda at the Center: 387-6311.





S ALL IN THE TOUCH... Vancouver International Airport nployee Jean Brighouse demonstrates the Communi-caid prototype used to assist disabled travellers find lodgings, arrange transportation and contact friends over the summe months. Transport Canada says the service was well-received.

Photo by Dave Freedma

Ground-level help for disabled fliers

By DIANE STRANDBERG

Hearing, speech and vision npaired visitors to the Vancouver International Airport ow have some high-tech help enable them to get in touch ith hotels, transportation and friends.

The "Communi-caid", a ototype developed to provide formation and facilitate communication for travellers, s set up at the airport this mmer by Transport Canada d a group of design and technology companies and given a couple of months to prove its worth.

And operator Sheela McLean says the service has been well received.

"I found that people who came in to use the booth said they were glad to use it. I think we've been doing well, considering we're not that well publicized," McLean said.

The Communi-caid provides a flight monitor, and a video and audio message that offers information about wheelchair accessible hotels and Expo '86. The operator meanwhile, provides any other information needed.

It was developed by Rutenberg Design Inc. for the Transport Canada's development services, in conjunction with Teklogix Inc, which developed the software, and the Centre for Speech Technology Research, which helped provide the audio component.

One major feature of the Communi-caid is a "visual ear" a telephone hookup that provides hearing impaired travellers with a connection to other users of the technology. The traveller can "talk" to another visual ear user by typing messages onto a video screen.

"The visual ear came in very useful when a hearing impaired baseball team learned that their flight was delayed five hours and they all had to call home," McLean said.

COMMUNI-CAID

To be able to operate independently once you reach your destination is a dream for hundreds of disabled travellers. COMMUNI-CAID will turn that dream into a reality.

COMMUNI-CAID is an integrated communication system for sensory and speech impaired persons at transportation terminals. It was developed by Transport Canada's Transportation Development Centre and Rutenberg Design to make independent travel for disabled people easier, less stressful and safer.

This new technology is encased in a brightly-coloured, free-standing metal structure; it is modern, clean and esthetically pleasing. The ceiling is of light and sound-insulating material; the side panels are semi-transparent and provide visual and audio privacy. The flooring is resilient to provide tactile feedback for vision-impaired and blind people. Symbols and verbal signs are in English and French.

When you enter this simple, geometrical enclosure, you are faced with a graphic colour monitor that is complete with large control pad, a simplified table keyboard and a video monitor for flight arrivals and departures. A hand phone provides audio information for those who cannot read th printed work. If you need hotel information, there is a regul telephone. A map of the terminal layout? Yes, that's als available, and you can leave with a hard copy printout.

A simple visual menu on the monitor gives a variety o choices of information - flight times, washroom locations, terminal layouts, hotel accessibility and much more. The selection is made by pushing a control pad which activates the computer cursor; the system is simple and sensitive enough that paraplegics and quadraplegics (with some arm/hand movement) can manipulate the "hit" button to control the menu.

By selecting "Operator Assistance" on the screen menu a light on top of COMMUNI-CAID will pulse and an audio signal is activated at the Transport Canada information booth.

COMMUNI-CAID is state-of-the-art technology giving freedom of information to people who are blind and vision-impaired, hearing-impaired and deaf, speech impaired cognitively disabled, learning disabled and wheelchair users.

COMMUNICAID

— Communication Through Computer Aided Dialogue

by BRENT FOOTE

Communicaid is an impressive high-tech communications booth designed to provide the disabled traveller with instant information on such things as airport facilities, ground and air transportation, Vancouver hotels and EXPO 86.

The system was built by Rutenberg Design Inc. of Quebec and was commissioned by the Transport Development Centre, a branch of Transport Canada. A prototype is currently being tested at the Vancouver International Airport for the duration of EXPO, and any comments or suggestions from the travelling public are certainly welcome.

The first thing that hits you when you enter the Communicaid booth are all of the buttons, computer screens and keyboards that are available to choose from. This may initially discourage a person who hasn't used the system before, but it shouldn't. The system is designed to be as simple as possible for the first time user.

For example, when you first enter the booth an electric eye trips off a verbal introduction to the system. You then pull up to the main keyboard, and by simply pressing one button you receive instructions and menus on a computer screen. For the visually impaired, further verbal instructions are available using the latest in synthetic speech technology.

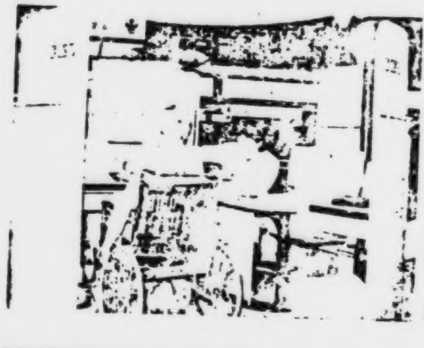


Photo Brent Foote

If you used the menu appearing on the screen to call up "Airport Washrooms, Level III," for example, you would get a visual diagram of this level with the wheelchair washrooms clearly marked. And if you decide that this map will be useful, the laser set printer will provide a print-out copy that you can take with you.

This method of accessing information and obtaining print outs is available for all the menus that are programmed into the computer.

So if you want to know what type of transportation is available or what hotels are accessible or how to get to EXPO and what's available when you get there, all you have to do is press the appropriate button.

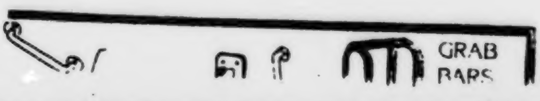
But, that's not all. There's also up-to-the-minute airline scheduling information on a separate video monitor. You just select from about five different airlines, press the appropriate button, and instantly you get a lot of all the arrival and depature times.

Another feature of Communicaid is the availability of an operator if you have any questions that the computer cannot answer.

The Communicaid booth at the Airport is the only one of its kind in the world and is still being refined and tested. It's currently in the "field study" stage, in which people are given the opportunity to try out the system, giving their evaluation. After enough data is collected, the system will then be shipped back to Quebec for more fine tuning before it is tested in other major Canadian airports.

After EXPO ends, the system may remain at the airport for a further six months. In the meantime however, the Communicaid will be available for testing on the third floor of the Vancouver Airport for anyone who's interested in evaluating the new system.

AMMUNDSEN



CNIB: NEWSLINK SUMMER 1986
B.C. / YUKON DIVISION

COMMUNI-CAID CENTRE AT VANCOUVER INTERNATIONAL AIRPORT

Transport Canada has announced the opening of the Communi-Caid Centre at the Vancouver International Airport.

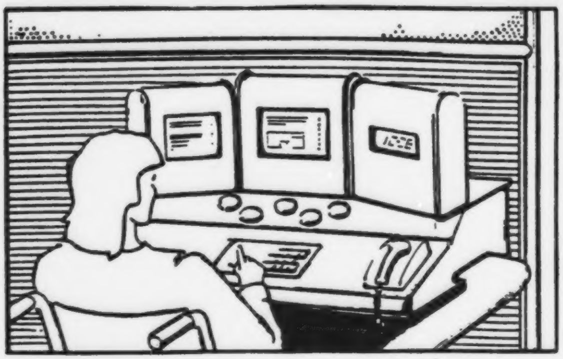
The Centre, which is a comfortable, roomy enclosure, was developed to provide information and facilitate communication for sight, hearing, and speech impaired travellers.

Communi-caid assists in questions about airport facilities, flight departures and arrivals, ground transportation,EXPO '86 accessibility, and hotels in the Vancouver area.

Information can be obtained through a computer in visual and audio displays. Communication can take place through a computer and with the help of an operator.

The Centre is a prototype and is being tested this summer by having as many people as possible, especially those with special needs, to use it and make any suggestions deemed necessary.

Transport Canada encourages any travellers with time or requiring information at the Airpot to take the opportunity to use the Centre.



AUDIBLE TRAFFIC SIGNAL LOCATIONS

Vancouver City Hall's Engineering Department announces that at present there are four pedestrian activated traffic signal locations that have audible devices attached to them. These are at:
Denman and Haro
Ontario at 33rd Avenue
Glen at Broadway
Main at 36th Avenue

Audible controls are also scheduled for 10th Avenue and Camosun.

TWO BRAILLISTS HONOURED FOR 25 YEARS OF SERVICE

Kathleen Maguire and Esme Mansell have been brailling textbooks, recipes and job support material for blind people for 25 years. Both were presented with Certificates for their long and dedicated service by Division Chairman Bob Nicholson at the B.C.-Yukon Division's Annual Meeting on April 24, 1986.

In 1961 Esme joined one of five braille classes for volunteers held by

dents these two braillists obtained their Transcriber's Certificates with flying colours.

On the day of the presentation both arrived with boxes of completed work, Kathleen with job support material for a blind person in the Yukon and Esme with job support material for a deaf-blind man.

They never come empty-handed and always take away another assign-

APPENDIX D

ERGONOMIC EVALUATION, Dr. RUTH HERON

ERGONOMIC EVALUATION OF COMMUNICAID:

A SYSTEMS ANALYSIS

Ruth M. Heron, Ph.D.
Ergonomist

JULY 1986

1.0 Introduction

This report describes and presents results of a systems evaluation carried out on Communicaid so as to determine system effectiveness from an ergonomic perspective. More specifically, the purpose of the analysis was to (i) force the emergence, in a systematic way, of system design features which violate human sensory, perceptual, cognitive, motor, and psychological limitations, and (ii) obtain an understanding of the nature of relevant modifications required to render the system ergonomically sound.

1.1 The Ergonomics Model

The theoretical basis of ergonomics sees the operator (and/or user) of any machine and the machine itself as parts of a single person/machine system, continually interacting with one another in exchanges of information. Briefly, the process involves input from the machine to the sense organs of the person who then processes this information in the brain, makes a decision about how to respond, executes a control or other response which affects the machine's behaviour and, upon receiving feedback about the nature of the response from the machine and the environment, enters the cycle again.

Clearly, the design of any person/machine system must be compatible with the capabilities and limitations of the human operator or user. Moreover, in order that design defects can be accurately pinpointed and that appropriate modifications can be recommended, any creditable ergonomic analysis of the system must be underlain by facile familiarity and understanding of the vast body of scientific knowledge relevant to the processes associated with these capabilities and limitations (Various introductory texts - Kantowitz & Sorkin,1983; McCormick & Sanders, 1982; Murrell,1965 - provide elementary accounts of this literature.)

This is not to say, of course, that no other evaluative information regarding a system should be considered. On the contrary, in keeping with Garner, Hake, and Erikson's (1956) notion of multiple operationism, the strategy for evaluating Communicaid involves several approaches all of which will converge toward a total assessment picture. The task analysis is that component of these approaches which is the most systematic, inclusive, and objective, and which provides recommendations based on scientific fact about humans' sensory, perceptual, and motor functions, their information-processing capabilities, and their psychological dispositions.

2.0 Method

2.1 Selection of Analytical Approach

Basically, the systems analysis consisted of a series of task analyses. encompassing various activities carried out in the work station. "Task Analysis" is a generic term subsuming many methodological approaches to analysis of the operator's task during interaction with some machine system. All are underlain by the theoretical ergonomic model described above. A modified version of the task classification system developed by Berliner, Angell, and Schearer (1964) was selected in this case because (a) it is suitable when, as is true here, outcomes are to be used for purposes of system design and development, as opposed to operator assessment or training, (b) it emphasizes communication and cognitive (information-processing and decision-making) processes as well as perceptual and motor ones, all of which are important aspects of the tasks imposed on Communicaid operators, and (c) it is simple and easy to use.

2.2 Design of Interview Protocols

The design of interview protocols followed the format implicit in the Berliner et al. (1964) approach. Each feature of the system was defined (eg. exterior signs and symbols), its functions articulated (eg. attract potential user, inform potential user that Communicaid helps with communication), and its user activities identified (eg. detect sign and symbols, discriminate and identify symbols, interpret message, decide enter/not enter). The protocols include space for entry of (i) observed difficulties relating to user activities (ii) recommendations for the type of design modification necessary to remove the difficulty, and (iii) relevant comments. (Tables 1 to 18 presenting results follow this format.)

2.3 Subjects

The subject pool comprised seven volunteers who interacted with the computer either as disabled users or as the system Operator, as follows:

1. middle-aged male, totally blind
2. middle-aged female, severely sight-impaired
3. young female, partially sighted
4. young male, totally deaf, speech-impaired
5. young male, wheelchair-bound, poor finger dexterity, no sensory defects
6. young female, no sensory or motor impairments, acting as system Operator
7. young female, no sensory or motor impairments, acting as system Operator

In usual ergonomics parlance, the term "operator" implies any person who exerts control responses on a machine, while the term "user" implies a person who uses an engineered system, such as a chair, which does not involve this type of interaction. According to this sheme, travellers who use Communicaid are certainly operators of the system. However such travellers have the option of entering into a computer-aided dialogue with another person who, analogous to counterparts in a telephone system, was called at time of testing the "Operator". This person is of course also an operator of part of the system. To distinguish between the two types of operators, only the latter will be referred to in this report as the Operator, while the term "user" will always imply an operator who is a traveller, actual or potential.

Unlike studies designed to test hypotheses, the one at hand had as its purpose the detection of system design features which are incompatible with capabilities of potential users or Operators. Accordingly, only a small sample of subjects was required. The one above was chosen so as to cover all possible disablements and all possible interactions with the system and, thus, to permit a comprehensive evaluation to be conducted.

2.3 Procedures

Each subject was treated individually. Each of subjects 2 to 5, first asked to attend to the signage, form, and other details of the exterior of Communicaid while approaching it from a distance, was subsequently queried about these features.

Next, each of subjects 1 to 5 was asked to step inside the Communicaid work station and proceed to use the system as if he/she were a passenger seeking various types of information. After interrogation, each was asked to experiment further with the system, to include an Operator/user dialogue in selection of options, and to examine all interactions with the system critically. Subsequently each was again questioned about his/her experiences.

Finally, subjects 6 and 7, separately, were observed in the role of Operator in simulated Operator/user dialogue sequences with user subjects, and subsequently questioned about system features relevant to these sequences. As, in these cases, the users were only subjects and not travellers, the subject Operators could not carry out actual passenger pre-processing operations. This part of the system must be submitted to real-life testing.

In all cases the questioning focussed systematically and in detail on difficulties experienced in carrying out user or Operator activities associated with a given system feature and, hence, which interfered with the feature's ability to fulfill its defined function. Observation and interviews with each of subjects 1 to 5 occurred over a period of about 3 hours, those with subjects 6 and 7 over a period of about 1 hour.

3.0 Results

3.1 Presentation of Outcomes

To facilitate the reader's task, (a) some features (eg. separate menus) have been combined into a single feature, and (b) outcomes are collapsed across user and 'Operator' groups respectively. The syntheses of these outcomes are presented feature by feature in Tables 1 to 18 which follow the interview protocol format.

4.0 Final Recommendations and Conclusions

It will be clear from Tables 1 to18 that many modifications to Communicaid are needed before it is fully sound ergonomically. Clearly, the most important of these, if they are to be reckoned in terms of optimizing use of the system by the target populations and hence eventually marketing it, are those to the screen and voice presentations. In both cases, the material needs to be carefully reviewed, edited, and reformatted in order that its perceptual properties are such that the information-processing load on the user is minimized and comprehensibility is maximized. Moreover, and this cannot be stressed too strongly, **the revised formats should be submitted to small-scale empirical tests as the modification work proceeds.**

Together, the modifications cited above and others presented in Tables 1 to 18 make up a rather formidable list. However it is not more than can be expected from a systems evaluation, inclusive and detailed as it is in nature, especially if the object of analysis is a Mark I prototype.

In any case, results of this study are dramatic in showing that the **concept** of Communicaid brings about enthusiastic endorsement by the disabled. This outcome is reinforced by reports from the two monitors who recorded comments from numerous disabled passengers visiting Vancouver during Expo 86 and who volunteered to try the system out. Unequivocally, the target populations see the system as one which can increase their independence in travel in a high technology way that is psychologically acceptable, if not to say exciting, to them. Not a shred of stigma attaching to use of the system was in evidence and, indeed, as numerous nondisabled travellers have been observed using Communicaid, it obviously does not present risk of being regarded as a system which segregates the disabled.

In view of all of the foregoing, it would seem that development of a Mark II, based on eliminating the problems outlined in Tables 1 to 18, would be a most desirable next step.

TABLE 1 - Exterior Design

Feature	- cylindrical shape of kiosk, metal mesh construction, sea green and red colouring
Function	- attract potential user - aid attention to signage - encourage decision to enter
User Activities	- scan environment - attend system - inspect system
Problems	- none observed

Comments

Responses from all subjects suggest that the external appearance of Communicaid is psychologically pleasing. While social desirability effects in field research have been well known for some time (Edwards, 1957), it is difficult to invoke them here. In open-ended replies, subjects remarked about the high technology appearance of the kiosk, an attribute that is undoubtedly appealing to the computer-age generation. Moreover comments from the numerous non-subject travellers, who stopped in passing to inspect the kiosk and frequently stepped inside to operate the system, suggest that the aesthetic properties of the exterior are sound, especially for the 18 to 55 group. Those in higher age groups may be somewhat diffident with respect to high technology information systems. However the elderly appear to be increasing their travel behaviour and, as Communicaid is only one of many such systems they will encounter during their adventures, it should not be long before it appears to them as a normal part of the environment.

TABLE 2 - Exterior Signage

Feature	- letters COMMUNI-CAID & symbols for sight-, hearing-, speech-, & motor-impaired
Function	- inform that system can help communication-impaired
User Activities	- detect sign & symbols - discriminate & identify symbols - interpret messages - decide enter/not enter - enter/pass on

Problems

- partially sighted cannot detect/discriminate/identify symbols
- fully sighted have difficulty detecting symbols; in particular, wheelchair bound must crane neck to see
- word COMMUNI-CAID + symbols convey to sighted that help with communication is available, but uncertainty exists re type of help
- young fully sighted subject would enter out of curiosity, but uncertainty re function of Communicaid on part of partially sighted would strongly influence decision to enter
- word INFORMATION at rear of kiosk creates confusion; seen by numerous nondisabled travellers who turn around to scan the environment while on the ascending escalator directly behind the kiosk: hmence monitoring Operators deluged with verbal information rerquests normally dealt with by attendants at the Transport Canada information counter in front of Communicaid.

Recommendations

- remove word INFORMATION at rear of kiosk; replace with COMMUNICAID
- enlarge symbols to 20.3-cm square; maintain high figure/ground contrast; place at lower level to accommodate wheelchair users
- include feature to reduce uncertainty regarding nature of Communicaid; eg. high-contrast black/white stick-man drawings symbolizing what users will do inside the kiosk and what type of information they will get

Comments

In addition to those stopping at Communicaid with short requests for information, numerous other apparently physically normal travellers were observed venturing inside to experiment with the system. This usage of the system should likely not be discouraged since it may be an important way of conveying news about its availability to disabled friends or relatives. At the same time, the present signage and symbols are very clearly unable to convey a reasonably precise notion of the intended function of Communicaid to the target populations. To remove uncertainty and facilitate a decision to enter on the part of these groups, all three recommendations above should be implemented.

TABLE 3 - Passenger Entrance

Feature	- 1.4-m opening with metal tubing lip
Function	- allow entrance to work station - expose sighted to visual introductory loop - trip off auditory introductory loop
User Activities	- step or wheel over lip into work station

Problems

- metal lip creates resistance to revolving front wheels of wheelchair and causes partially sighted to trip
- metal lip is separating from kiosk floor, creating additional tripping hazard

Recommendations

- flatten metal lip and secure to kiosk floor
- possibly provide simple talking light system to warn partially sighted of obstacles

TABLE 4 - Interior Design

Features	- layout of work stations - arrangement & properties of furniture & fixtures such as handset, wall telephone, visual ear, etc. - lighting
Function	- to facilitate comfortable use by target populations
User Activites	- move chair (if in wheelchair) - sit at desk - locate controls & equipment - reach controls & equipment - perform sensory & motor tasks

Problems

- moving desk chair difficult for wheelchair occupant
- blind cannot see chair & desk - tend to stumble over them
- colour contrast of fixtures not good enough for partially sighted
- Operators found keyboard in awkward position
- Operator forced into adverse position to retrieve computer lock key under desk - has to bend and twist head
- Operators experience visual dazzle from green screen
- female Operator has no place to store handbag

Recommendations

- maximize roll property of desk chair
- prepare sight-impaired for what to expect in interior; a tactile map with appropriate 3-dimensional description might be helpful
- change colour of handset, wall telephone, etc. to dark red
- provide space for Operator to move keyboard into comfortable typing position
- store computer lock key in more accessible place - eg. closer to front of desk - or design alternate protected locking system
- check & eliminate source of glare on Operator's screen
- provide storage space for female Operator's handbag under desk

Comments

The above recommendations are very minor in terms of the overall interior design which, in all but a few respects, was exceedingly accommodative of the anatomical and other characteristics of users and Operators. In particular, subjects commented on the comfort of the chair provided and on the ease with which most fixtures within the station could be reached. The cylindrical shape of the work station is apparently psychologically pleasing, giving a sense of desirable enclosure, while the metal mesh construction adds airiness to the privacy. The positioning of user and Operator work areas, such as to afford privacy but with eye contact (if desired) easily possible, drew appreciative comments from all subjects; it reinforces the user's feeling of independence. The high technology atmosphere of the entire interior is particularly attractive to young users. No complaints regarding lighting were recorded.

TABLE 5 - Visual Introduction

Feature	- introductory visual loop, screens a to e, with a French counterpart alternating
Function	- instruct sighted re Communicaid functions & components - allow choice English/French - allow choice visual/audio menu - allow start with main menu (screen 01) - obtain ratings on Communicaid
User Activities	- detect, recognize, discriminate, interpret words/letters - store information in short term memory - scan, inspect diagram on screen c, compare diagram/real layout, identify components, store in memory - compare keyboards - store instructions in memory - decide stay/leave - decide English/French - decide visual/audio - decide rate Communicaid/not - move cursor, press hit

Problems

- audio introduction interferes with processing of visual information
- ambient noise reduces users' information-processing capacity, affecting (in particular) reading time, comprehension, and ability to retain information in memory
- switching to other language after first screen gives impression that introduction is over - if user chooses "start" on any of the five screens, system starts presentation of main menu in language of last introduction screen; if that screen was not in user's preferred language, he/she becomes exceedingly frustrated as there is no way to get back quickly into other language
- user cannot completely bypass visual menu system and get to Operator until after menu 01 (i.e. user must select an option from menu 01 before he/she can exercise option to get to Operator)
- user cannot self-pace; self-pacing is extremely important with target populations

- meaning of "Operator", for dialogue partner, unclear; interpreted as telephone operator
- meaning of "start" not clear - eg. on screen d, user thinks "start" gets him/her to Operator, whereas it actually starts main visual menu
- meaning of yellow flasher on introductory screen inconsistent with that on menu screens (i.e. "start" on former and "select" on latter)
- instructions re hit button not clear; subjects looked at keyboard to find cursor pad
- system diagram is inconsistent with layout of actual system
- Questo can produce very unreliable information as (i) not every one will complete (users who pressed "start" earlier will miss it, others will find it a nuisance), (ii) some will deliberately misuse, (iii) the questions are neither explicit or general enough
- readability low, thus creating high mental load and impatience with system - factors as follows:
  - screen density too high
  - dimensions of characters not optimal
  - spacing of words etc not optimal
  - formatting of text does not facilitate perceptual organization
  - contrast not high enough in some cases for partially sighted

Recommendations

- install mechanism for user option of switching off audio
- control ambient noise with noise absorbing materials; do not relocate work station unless can improve on resent very good location
- eliminate alternating French and English screens; instead, present an initial static screen with (i) one simple instruction advising in English that pressing "e" will start the introduction in English, and advising in French that pressing "f" will start the introduction in French, and (ii) the advice in English and French that pressing the hit button will hold subsequent screens; this screen to stay on until user presses e or f; all subsequent screens to be in the same language, until user selects option to use other language; include options on subsequent screens allowing the user to (i) get back into the other language (to offset error of starting in the wrong language), and (ii) return to the previous screen
- include option to summon the 'Operator' on the same screen as it is defined, and on each subsequent screen
- advise user on introductory (static screen) that can hold screen by pressing any cursor button

- substitute "information agent" or simply "agent" for "Operator"; do not use "attendant", as this connotes some one who assists with feeding and toiletting and, therefore, equates with dependency in the mind of the disabled
- substitute "main menu" for "start"; or otherwise clarify
- maintain consistency of meaning of yellow flasher to indicate "select" on introductory screens as well as menu screens
- clarify instruction re control pad (see Table 12 re control pad)
- correct system diagram
- omit Questo
- improve readability as follows:
  - reduce screen density to between 20% & 30% of available character space; elminate unecessary words - eg. YOUR & THE; use & for AND
  - ensure ratio of letter width to height is between 1:1 & 3:5, and stroke width about 1/6 letter height
  - increase size of punctuation marks & amount of space between words, more so after punctuation marks; make brackets larger than letters
  - reformat screens using principles for maximizing perceptual organization; make use of boldfacing for coding & grouping
  - maintain positive polarity if illumination remains high - reverse if illumination is low; increase brightness contrast (black on white is best)

Comments

A consistent complaint regarding the visual introduction was that it was time-consuming to read. This is due to a number of factors which combine to create mental load. Any frustration in using the system will drive potential users away. Therefore, to ensure that the system will be used and thereby have high marketability, the above mentioned recommendations should be taken seriously. Reformatting so as to optimize perceptual organization is particularly important, as this is an early-occurring process which results in the division of the field into small perceptual units and, hence, facilitates the selective attention process as it works to separate figure from ground.

In general, these recommendations are based on known principles of human perception and cognition (Collins & Erikson, 1967; Kahneman &

Henrik, 1977; Mayzner & Gabriel, 1963; Taylor, 1961; Treisman, 1982; Vitz, 1966). That on screen density is based on a review of current relevant empirical studies (Tullis, 1983), those for letter dimensions on tested United States Military Specifications.

TABLE 6 - Menus

Feature	- Main menu (screen 0.1) and secondary menus: Flight Information (screen 1.0), Airport Facilities (screen 2.0), Ground Transportation (screen 3.0), Airline Counter Locations (screen 4.0), Expo & Canada Pavilion (screen 5.0), Hotel Accommodation (screen 6.0)
Function	- inform re categories of information - allow choice category/previous screen/introduction/end (&, on secondary menus, /Operator)
User Activities	- detect, recognize, discriminate, interpret letters/words - store information in short term memory - decide re category/previous screen/introduction/end (&, on secondary menus, /Operator) - move cursor - press hit

Problems

- if user does not press hit button in time, introductory screens come up again
- user must select something from Menu 0.1 to exercise option to summon Operator
- instruction on screen 1.0 re getting to black & white monitor not clear
- inset options on screen .1 (eg. return to previous screen, etc.) are phrased differently on other screens
- readability & contrast problems, & consequent effect on mental load, are as for introductory screens (see Table 5)

Recommendations

- advise user on first (static) introductory screen how to hold screen
- see Table 5 re recommendation on option to summon Operator

- change wording on screen 1.0 to read as follows:

FOR DEPARTURE & ARRIVAL SCHEDULES FOR

▾ Air Canada ▾ Canadian Pacific Airlines ▾

▾ Pacific Western Airlines ▾ Xxxxxx Xxxxxxxx Airlines ▾

USE **BLACK** SELECTION BUTTONS & SCREEN **TO YOUR LEFT**

- standardize wording of options throughout; format on screen 0.1 is fairly good since it eliminates the word "for" and, hence, allows for a lower ratio of characters to character space; an even more economic form, if small-scale user comprehension tests are positive, would be simply as follows:

PREVIOUS SCREEN
INTRODUCTION
END SESSION

- see Table 5 for recommendations on readability - examples of more economic wording are as follow:

- on menu .1, change heading to read

INFORMATION CHOICES

- on all menus, change instruction to read, for example,☐

TO SELECT, MOVE CURSOR TO CHOICE & PRESS GREEN BUTTON

Comments

Black figures on white ground provide the highest contrast. Therefore, to facilitate information-processing by any partially sighted users who nevertheless prefer the visual mode, this combination should be favoured, with coding and accentuation of figure/ground effects being achieved by appropriate spacing, use of boldface letters, and formatting in accordance with principles of perceptual organization. Still, according to Taylor(1986), colour can be very effective in aiding perceptual organization; therefore, if used knowledgeably, colour could serve to increase readability while adding interest and excitement to the displays.

TABLE 7 - Information Screens

Feature	- locations of airport facilities (screens 2.1 to 2.4), ground transportation (screens 3.1 to 3.6), locations of airlines counters (screens 4.1 to 4.2), Expo & Canada Pavilion facilities & transportation (screens 5.1 to 5.3), hotels in central, west, east, north, & south Vancouver
Function	- provide user with specific information in chosen areas
User Activities	- detect, recognize, discriminate, interpret letters/words - search for targets - store information in short-term memory - decide re copy/map-printout/previous screen/ main menu/Operator/leave

Problems

- format for departure time, travel time, & fare inconsistent across screens 3.1 to 3.6
- choice of map not obvious on some screens
- readability only fair on most screens, less than fair on screens 6.2 to 6.8 where screen density is very high

Recommendations

- standardize format for departure time, travel time, & fare information across screens - eg.

DEPARTURE TIME	EVERY 15 MIN. WEEKDAYS EVERY 20 MIN. SAT & SUN
TRAVEL TIME	XXXXXXXX
FARE	$5.75 ONE WAY • $9.50 RETURN

- list map option with other options - eg.

  MAP
  OPERATOR
  PREVIOUS MENU
  MAIN MENU

- pale colour highlighting of names may aid discriminability - remove unnecessary brackets (see examples below) - see Table 5 for other recommendations re readability

eg. 1

MEDICAL CLINIC LOCATED ON LEVEL 1 - U.S. & Overseas Arrivals

eg. 2

HOTELS - Vancouver North

S = SINGLE   D = DOUBLE   T = TWIN

TABLE 8 - Map Screens

Feature	- maps for facilities and services at Vancouver Airport - restaurants etc. (screens 2.1.1 to 2.1.3); elevators etc. (screens 2.2.1 to 2.2.3); washrooms etc. (screens 2.3.1 to 2.3.3); telephones (screens 2.4.1 to 2.4.3); currency exchange etc. (screens 2.5.1 to 2.5.3); medical clinic (screen 2.6.1); car rental agencies (screen 3.6.1); airlines (screens 4.1.1 to 4.1.4 & 4.2.1 to 4.2.3) - maps for Expo 86 - facilities etc. (screen 5.1.1); monorail & skytrain (screen 5.2.1); SCAT (5.3.1)
Function	- provide user with visual spatial information re location of specific services and facilities
User Activities	- detect, recognize, discriminate, & interpret visual patterns - identify target area - determine route to target area - store patterns & route in short term memory - decide re copy/printout/previous screen/main menu/Operator/leave

Problems

- large size of coloured area on maps makes brightness contrast too great (stimulus dazzle is being created), thus reducing sensitivity of entire retina, & creating negative (dark) afterimage on next screen in some cases
- use of fuschia colour inappropriate for colour blind; it is also too saturated & is therefore sometimes creating a complementary (green) afterimage on next screen
- location of washrooms on Level 1 reported as incorrect (screen 2.3.1)
- entrance arrows not discriminated from exit arrows - they are perceived as one figure, the meaning of which is not understood until further inspection has taken place
- insufficient labelling on maps
- readability problems as for other screen material

Recommendations

- change fuschia colour of maps to light blue; cross-hatch or dot slightly to reduce dazzle effect

- check location of washrooms on level - correct map if necessary
- add labels to unidentified parts
- make entrance/exit arrows slimmer and parallel to each other
- see recommendations in Table 5 for improving readability

Comments

The effects of large bright and dark surfaces on the retina, in particular their association with a reduction of visual acuity in the fovea, are referred to by Grandjean (1980, p. 122). Bartley (1969, p. 124) gives a brief description of various types of afterimages. The difficulties of the colour blind in identifying reds are well known; they are mentioned by Kantowitz and Sanders (1983, p. 128) who also report that 8% of European males have some form of dichromatism. Although identification of one part of the maps as red per se is not important in this case, the essential task being to distinguish it from a black part, blue would appear to be a safer choice as absence of or weakness in perception of blue is extremely rare (see Bartley, 1969 p. 135). Moreover a typical luminosity curve indicates that a wavelength of, say, 475 (at the blue end of the spectrum) will not be perceived as being as bright as a wavelength of, say, 620 (at the red end of the spectrum); hence, the dazzle effect experienced from the red map colouring would be subdued. A very light cross-hatching would reduce possible dazzle even further by interrupting the spread of the coloured patch over the retina.

TABLE 9 - Dialogue Screens

Feature	- unnumbered screen following selection of "Operator Assistance", & message screens 001 to 004
Function	**unnumbered screen** - allow users to select suitable dialogue mode (hearing-impaired speaks, Operator types - speech-impaired types, Operator speaks) - allow users to select one of three keyboards **screen 001** - allow speaking user to view Operator's typed responses **screens 002, 003, 004** - allow typing user to use, respectively, graphical Qwerty, graphical alphabetical, or hardware keyboard - allow typing hearing-impaired user to view Operator's typed responses
User Activities	- detect, recognize, discriminate, interpret letters/words in structions - decide re communication mode - decide re keyboard - visually detect,recognize, & discriminate keyboard letters - decide re message to Operator & selection of relevant keyboard letters - operate keyboard to send message to Operator - receive & interpret response from Operator - decide re previous screen/main menu

Problems

- instructions re communication mode unclear
- screen keyboards time-consuming to operate
- absence of erase feature prevents correction of errors
- absence of punctuation keys prevents logical separation of word and thought units
- when screen fills up with return message, whole message fades & new part returns on next line, thus interrupting efficient message reception and interpretation

Recommendations

- change text of instructions to user & reformat in order to clarify (see example on next page) - possibly drop alphabetical keyboard which is rarely, if ever, used
- allow for continuous motion of cursor by directional control buttons, as recommended in Table
- include erase key & comma key, as recommended for hardware keyboard
- include scrolling feature to avoid delay & discontinuity of messages

Comments

Subject reports indicate that the existence of the screen keyboard options will add much to the overall function of Communicaid, once modifications enabling them to be used in an efficient manner have been implemented. These modifications relate to the location, configuration, and operation of the control pad rather than to the keyboards themselves. The salient fact here is that the technology must improve on existing methods; and, since hearing- and speech-impaired travellers have become extremely efficient with the paper/pencil/posturing techniques they now use for communication, some thought might be given to other modes of key selection. Touch screens, for example, albeit associated with hygenic and anatomical problems, certainly ensures a swift selection process.

Example 1. Instructions to user, altered in content and format so as to increase comprehension (assuming only QWERTY screen keyboard)

WHILE WAITING FOR INFORMATION AGENT, CHOOSE COMMUNICATION MODE 1,2, OR 3

IF YOU WISH TO SPEAK, CHOOSE
1. YOU **SPEAK**/AGENT TYPES.. 0 (001)

OR, TO TYPE MESSAGES **BY MOVING CURSOR** ON A **SCREEN** KEYBOARD, CHOOSE
2. YOU **SCREEN TYPE**/AGENT SPEAKS OR TYPES.................

OR, TO TYPE MESSAGES USING **TABLE** KEYBOARD IN FRONT OF YOU, CHOOSE
3. YOU **TYPE** WITH **TABLE** KEYBOARD/AGENT SPEAKS OR TYPES........

PREVIOUS SCREEN...0
MAIN MENU.. 0

Example 2. Instructions to user, altered in content and format so as to increase comprehensibility.

WHILE WAITING FOR INFORMATION AGENT, CHOOSE COMMUNICATION MODE 1,2,3, OR 4

1. YOU SPEAK/AGENT TYPES.. 0 (001)
2. YOU TYPE ON KEYBOARD A /AGENT SPEAKS OR TYPES. 0 (002)
3. YOU TYPE ON KEYBOARD B/AGENT SPEAKS OR TYPES.. .... 0 (003)
4. YOU TYPE ON KEYBOARD C/AGENT SPEAKS OR TYPES.................... 0(004)

EXPLANATION FOR 2, 3, & 4

- KEYBOARD A & KEYBOARD B

▾ WILL BE ON SCREEN ▾ LETTER SELECTION BY MOVING CURSOR
▾ AGENT TYPES OR SPEAKS – YOU CHOOSE

- KEYBOARD C IS IN FRONT OF YOU, ON THE TABLE

PREVIOUS SCREEN..0
MAIN MENU.. 0

TABLE 10 - Printout of Lists of Information

Feature	- hard copy reproduction (black figures on green paper) of information list screens - screens 3.1 to 3.5 (ground transportation) & screens 6.1 to 6.8 (hotels in central, west, east, north, and south Vancouver)
Function	- overcome load on short term memory associated with soft copy presentation
User Activities	- detect, recognize, discriminate, interpret letters/words - search for targets

Problems

- user cannot find printout
- readability low - figure/ground brightness contrast may be insufficient for partially sighted; green may be problematic for some dichromatics

Recommendations

- clarify instruction regarding location of printout and how to retrieve it - identify printer slot with flashing light
- see Table 5 for recommendations on improving readability - use lighter coloured paper for better brightness contrast; blue is likely preferable to green to avoid colour sensitivity problems among dichromatics.

Comments

Problems of readability will be solved when the relevant screen counterparts are modified in accordance with recommendations set out in Table 5. Apart from this and the readily solved difficulty of finding the printout, the general reaction from all participants to the list printout feature was very positive indeed, and to the effect that it was decidedly helpful.

Table 11 - Printout of Maps

Feature	- hard copy reproduction (black figures on green paper) of map screens - Vancouver Airport (screens 2.1.1 to 2.1.3; 2.2.1 to 2.2.3; 2.3.1 to 2.3.3; 2.45.1 to 2.4.3; 2.5.1 to 2.5.3; 3.6.1; 4.1.1 to 4.1.4; 4.2.1 to 4.2.3): and Expo 86 (screens 5.1.1, 5.2.1, and 5.3.1) (see Table 8 for titles)
Function	- overcome load on short term memory associated with soft copy presentation
User Activities	- detect, recognize, discriminate, interpret patterns - identify target area - decide route

Problems

- user cannot find printout
- additional problems same as last four on Table 8 - figure/ground brightness contrast may be inadequate for partially sighted; green/black colour contrast may be problematic for some dichromatics

Recommendations

- clarify instruction for location of printout & how to retrieve it - identify printer slot with flashing light
- additional recommendations same as last four on Table 8

Comments

As for the printout of lists of information, problems of readability will be overcome by modifications made to the soft copy versions. The hard copy map feature of Communicaid elicited extremely positive reaction from subjects. Copying information from the screens may be difficult for those with lower limb motor deficits or, in any case, inconvenient, requiring as it does ready availability of pencil and paper. The printout eliminates these problems along with the alternative one of committing the information to short term memory.

TABLE 12 - Printout of Seat & Flight Selection

Feature	- hard copy recap of results of flight arrangements made during dialogue with Operator
Function	- assist communication-impaired passenger during passenger handling procedures at ticket & check-in counters
User Activities	- retrieve printout - take to ticket or check-in counter

Problems

- observations not possible under simulated conditions

Recommendations

- test feature under real-life travel conditions

Comments

When questioned, sight-, hearing-, & speech-impaired subjects reported that they felt this feature would be very useful provided the system could be altered so as to render it more efficient in dialogue sequences pencil, paper, and posturing are now.

TABLE 13 - Control Pad

Feature	- set of 4 directional buttons and 1 hit button
Function	- allow user to move cursor to choice & communicate selection to computer - allow user to hold a given screen in view
User Activities	- decide re direction - select appropriate button - reach button & press; repeat &/or switch if necessary, until target reached - press hit button

Problems

- user is not informed of the holding function
- cursor pad too far for comfortable reach; user must rest arm on keyboard
- arrangement of buttons not fully answerable to principle of stimulus compatibility; therefore user slowed up in selections
- control of screen keyboards slow as cursors move only one space at a time; hence user becomes frustrated during dialogue sequences

Recommendations

- inform user of holding function
- move cursor pad to right of keyboard
- around central hit button, arrange 4 directional buttons to accord with their respective directions of movement
- implement some mechanism allowing for option of continuous movement of cursor, or design alternate selection mode

Comments

The size of the control buttons makes use possible by those lacking finger dexterity who can, accordingly, activate the buttons using a fist. However, all the problems cited above were consistently reported by subjects, some of whom commented that the slowness of carrying out dialogue using a screen keyboard would induce them to revert quickly to the pencil, paper, and posturing indicators they now use.

TABLE 14 - Hardware Keyboard

Feature	- Qwerty type hardware keyboard in front of colour monitor
Function	- allow sighted users with speech or hearing difficulties to solve flight selection & other problems by communicating with the Operator - allow visually-impaired users to make selections from audio menus & to control presentation
User Activities	**fully sighted** - visually detect, recognize, & discriminate keys - select & press in accordance with decided on message **sight-impaired** - conduct visual or tactile search for keyboard - locate any single key & press in accordance with audio instruction

Problems

- keys too close together to avoid numerous typing errors
- absence of erase feature prevents correction of errors
- absence of simple punctuation prevents separation of series of word & message units
- user of audio mode needs to press key several times to get response

Recommendations

- use normal spacing of keys
- include erase key & back spacer for error correction
- provide comma (,) key for word & thought separation - other punctuation not needed
- alter audio instruction re way to press key for selections & control

Comments

The shape of the keys is compatible with the shape of the fingers and tactile feedback is good. Moreover, subject reports indicate that simplification of the keyboard reduced search time. However, to avoid frustration on the part of the speech-impaired user attempting to overcome expression difficulties, as well as on the part of the Operator attempting to interpret the user's messages, the above recommendations should be implemented.

TABLE 15 - Telecommunication Fixtures

Feature	- wall-hung telephone, visual ear
Function	- complement system, allowing users to make telephone arrangements immediately on receipt of information re hotels, services, etc - visual ear extends function to hearing-impaired
User Activities	- locate, & reach instruments - operate instruments

Problems

- sight-impaired cannot find telephone on basis of instructions in synthetic voice presentation
- visual ear of inferior quality (said worst on market by hearing-impaired subject) - random messages appear on user's screen

Recommendations

- express telephone location directions in terms of clock positions & distance
- replace visual ear with higher quality device

Comments

The observed problems are easily solved. Subject reports indicate that the comprehensive approach of including these devices in the system is appreciated; it is seen as enabling them to save energy usually expended on searching for devices which accommodate their special needs.

TABLE 16 - Airlines Schedules

Feature	- black & white monitor & black airline selection control buttons, to left of users' colour monitor
Function	- provide departure, arrival, & flight number information for four airlines - Air Canada, Canadian Pacific Airlines, Pacific Western Airlines, & United Airlines
User Activities	- decide re airline - press control button - detect, recognize, discriminate, & interpret letters/words - search for, detect, & interpret target entry - store in short term memory

Problems

- inconsistency in letter style & size across airlines impairs overall readability (CPA particularly poor)
- brightness contrast for some airlines insufficient
- columns on CPA output not labelled (as for PWA for example)
- labels on control buttons not clearly recognizable

Recommendations

- if economically feasible, improve readability of output by decreasing screen density, altering letter dimensions, and formatting in accordance with principles of perceptual organization, as set out in Table 5
- adjust brightness contrast where possible
- if possible, standardize labelling across airlines
- colour code control buttons; label with large black initials in letter-style of relevant airline

Comments

The above recommendations are made with full awareness of the fact that, at this point, it may not be economically feasible to carry them out. They should, accordingly, be regarded as refinements which can be incorporated into future versions of Communicaid to render it ready for a sophisticated market. Meanwhile, comments from subjects in this study were to the effect that, even with its defects, the provision of schedule information is a welcome feature which overcomes the numerous disadvantages of trying to obtain similar information from monitors placed well above normal eye level in a noisy and bustling environment.

TABLE 17 - System for Sight-Impaired

Features	- audio loudspeaker introduction; handset for receiving audio menus; synthesized voice menus; colour monitor; keyboard
Function	- enable sight-impaired to receive the same information as the visually capable, & to control output
User Activities	- detect, recognize, discriminate, & interpret words & word patterns in audio intro - locate handset - detect, recognize, discriminate, & interpret words & word patterns in audio menus - detect, recognize, discriminate, & interpret key words on monitor - integrate auditory & visual information - store in short term memory - decide re choices - locate keyboard - operate key to obtain selection - locate other objects (eg. telephone)

Problems

- instructions in intro for locating handset difficult to follow; could not find handset
- some high frequency synthetic voice sounds in audio menus not recognizable, especially by elderly who tend to lose these
- format of menu presentation violates principles of human information-processing; is also time consuming
- because of faulty menu format, key words on screen are not serving their intended function of providing redundant information and, thereby, reducing information-processing load
- brightness contrast between key words and background is not good enough for the partially sighted
- instructions in synthetic voice presentation for locating objects difficult to interpret; could not find keyboard
- instruction re pressing key for selection inadequate; user must press key several times, instead of once, to obtain selection

Recommendations

- express all instructions for locating objects, in intro & in synthetic voice presentation, in terms of clock positions & distance
- provide new chip for synthetic voice
- eliminate unnecessary words in menus
- revise presentation mode of menu items to accord with earlier advice for partially sighted users - key aspects of this mode are as follows: (a) listener should have an opportunity **both** (i) to hear all items before making selection & (ii) to choose an item known beforehand without having to wait until list is exhausted; (b) list should be kept to between 5 & 7 items, preferably fewer than 7, (c) a key word for each of these items should be decided on, and **entire set** should appear on **one screen** in enlarged letters, **at same time as first voice presentation** of list of items & **stay on** during the second (this is what is meant by "redundant coding"); & (d) selection by number (eg. 1 press for item #1 - 2 presses for item #2 - and so on) is advised - in this system, voice advises that (i) list consists of, say, 5 items, each numbered, (ii) key words, also numbered, will be on screen, (iii) selection made by pressing any key n times, where n is the number of selected item, (iv) user can make choice during first presentation, or wait for second - since first presentation will likely have built up a strong association between the key word or phrase & the item, second could possibly be in form of key words - if so, user should be advised at outset
- this system will, of course, not work for the totally blind - for this group, key words on screen will be of no use, & the list will therefore need to be repeated, with binary choice options at end of each item - however, as blind persons have generally trained themselves in short term memory retention, it may be satisfactory to use only key phrases, instead of the whole item, on second round - in that case, emphasis on key words during first presentation is a must - in the case above, it is very desirable
- increase brightness contrast of key words - use boldface black letters on white; if not large enough when all key words are on screen, use projection system
- change instruction re key press to accord with computer response system

Comments

Despite slight lack of distinctness on some high frequency sounds, all sight-impaired subjects reported that the synthetic voice was the best they had heard. One subject, who in his capacity as District Administrator of the CNIB in Vancouver had tested out many forms of synthetic voice, had no difficulty at all with the Communicaid version, not even with high pitched sounds; he regarded the quality as excellent.

The quality of the synthetic voice is extremely important for the Communicaid system, not only to remove as much as possible the stigma associated with anything smacking of artificiality, but also because some investigators report poor word recognition and increased processing demands in short term memory resulting from loss of acoustic cues characteristic of most forms of synthetic speech (Luce, Fenstel, & Pisoni, 1983). High quality should be expected from the speech technology used for this project because it preserves acoustic cues in two ways: first, by using long words and phrases as the basic units for storage instead of letters or phonetic segments and, secondly, by applying algorithms which change the form of the sound to accord with its context within concatenated parts of the vocabulary (Dickson, 1984). The slight problem experienced by some subjects in this study appears due not to the development technology itself but rather to the chip. It is understood that a higher quality chip will be forthcoming.

The recommendation that location instructions be expressed in terms of the clock system and distance accords with systems used to re-educate the blind. As sight-impaired subjects located objects unerringly when tested with this system during the evaluation, it would appear to be sufficient for the purpose. Tactile labels are not recommended for object recognition Most of the sight-impaired users of Communicaid (i. e. the partially sighted) will likely be capable of visually detecting and recognizing shapes such as the table, the handset, the keyboard, and the telephone. Moreover, even those who are totally blind ought to be capable of recognizing such objects through tactile perception, as they have undoubtedly become familiar with them through this mode in their daily lives. In sum, it is the detection process that is of concern here, rather than that of recognition; hence, tactile labels would seem to be unnecessary and might, in fact, interfere with normal tactile perception of the Communicaid environment.

TABLE 18 - Operator System

Features	- standard IBM PC AT monochrome monitor with standard keyboard; telephone connected to all airlines, security, ambulance, etc.; relevant furniture; audio & visual alert signal; printer switch;
Function	- facilitate communication between hearing- & speech-impaired users to overcome problems such travellers might experience at ticket or check-in counters, or elsewhere within terminal
Operator activities	- detect, recognize audio signal - detect, recognize visual signal - operate keyboard, printer switch, telephone - send/receive oral/screen messages - target group - send/receive telephone messages - airlines, services, etc.

Problems

- ambient noise makes audio signal impossible to detect
- visual signal difficult to detect from a distance
- scrolling creates lag in message reception; interpretation difficult
- interpretation difficulties increased by numerous errors in user's messages due to absence of erase and punctuation features on user keyboards
- valuable time spent explaining keyboard selection to user
- term "Operator" does not accord with user's expectations; user expects a telephone operator

Recommendations

- increase luminance of visual signal (audio signal is detectible at Transport Canada Information booth; therefore intensity need not be altered); install paging device if necessary
- alter scrolling mechanism to synchronize with messages
- to remove errors in user messages, see recommendations regarding screen & table keyboards
- to eliminate keyboard explanation time, see recommendations regarding introductory dialogue screen
- substitute term "Information Agent" or simply "Agent" for "Operator" - **do not use "Attendant"**, as this connotes to disabled some one who helps with feeding, toileting, etc. & is therefore equated with dependence - the term "Agent" has no such connotation

Comments

It is important to point out again that, because these analyses were based on simulated tasks, no observations were possible on interactions involving the Operator's use of the telephone for flight information or, as a consequence, the use of the printer for a hard copy version which the user could take to the ticket or check-in counters. These tests must be carried out later under real-life conditions.

The difficulties outlined above on observable aspects of this part of the system would seem to be decidedly minor, both Operators reporting that, from their perspective, dialogue sequences were relatively smooth and obviously fulfilling a necessary function.

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APPENDIX E

SYSTEM MODIFICATION REPORT, C. DICKSON

CENTRE FOR SPEECH TECHNOLOGY RESEARCH SOCIETY

REPORT ON SYSTEM MODIFICATIONS
to the
COMMUNI-CAID KIOSK

REPORT DATE: December 29, 1986

PERIOD COVERED: November 1 to December 22, 1986

PREPARED BY: B. Craig Dickson, Executive Director

PROJECT FILE No.: SS-TDC-86

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I. INTRODUCTION

Upon receipt of authorization to procede with recomended modifications to the Communi-Caid Kiosk on November 1, 1986, an evaluation of requirements was carried out and components were ordered or purchased. The software source code for system operations, backups of which were left with CSTR by Techlogix Inc., were transferred from 1.2 Meg disks to 360K disks to make them readible by the IBM XTs available at CSTR. The source codes were catalogued and evaluated, but in the absence of an IBM AT with extended memory and support facilities as is required for the Communi-Caid programs, the program could not be modified to any extensive degree.

The synthetic speech vocabulary files and the visual texts were examined to determine means of streamlining the data for information delivery and evaluation reports and recommendations were referred to in order to confirm the requested modifications.

On November 29, 1986, the IBM AT microcomputer and monitor, the Gigatek Monitor and graphics card and the Hewlett-Packard Laser Printer were removed from the Communi-Caid Kiosk and brought to CSTR's laboratory in order to perform the modifications. Ms. Jean Brighouse, the attendant in charge of the Kiosk at Vancouver International Airport, also came to CSTR in Victoria to assist in the modifications and to receive training in undertaking system updates.

On December 1, 1986, the Communi-Caid hardware was set up at CSTR. A software package was written on an IBM PC to emulate the user's keyboard and control panel and this was interfaced with the Communi-Caid hardware. A second software package was later written for an IBM XT to emulate audio and visual output of data for evaluation and editing. The following describes the modifications that were undertaken and installed in the Communi-Caid system.

II. GENERAL CHANGES

1. Following evaluation of the system, the software code was reduced to approximately one-third its former size, including updates, by removing redundant operations and simplifying calls. The excessive size of the code appears to be attributable to insufficient time allotted to general software clean-up following first implementation. The clean-up undertaken by CSTR resulted in accelerated operations in such cases as speed of audio response, including the bell tone, swithing between audio and visual modes, and switching between languages. System modifications were also simplified by reducing the code to a managable size.

   Many difficulties in software modifications were caused by undocumented library calls, peculiar to the "Lattice C" compiler that had been used when the program was first installed. While this is a good compiler, it is very difficult to get programmer's manuals to support it on a short order and we were unaware that these library calls were used in the program. (CSTR uses the more readily available "Microsoft C" compiler.) While all relevent documentation had been requested prior to removing the system from the airport, the absence of support documentation for the compiler inhibited our progress and added many hours of labour to the modifications.

2. Dome style noise-eliminating headphones were selected. Upon reinstallation of the system in the kiosk, these were installed to replace the Walkman style headphones first selected. The new headphones are equipped with a heavy telephone style cable, which was run directly through the console, secured by a retainer and wired to a rheostat which acts as a volume control for the output from the amplifiers. Instructions in the introductory message give the location of the headphones in terms that refer to clock directions.

   It was found after installing these headphones, which are more sensitive than the handset which was replaced, that the quality of the amplifiers used to condition the audio signals is extremely poor, with difficulties in obtaining an impedance match and in excessive amplifier noise. The amplifiers will therefore be replace within the next two weeks, and modifications to signal routing will be made to guarantee good quality.

3. A panel on the console was developed with the direction buttons mounted on it arranged in a diamond shape and the select button to the immediate right of the diamond. The panel covers the user's keyboard and may be tilted forward for access to the keyboard.

4. A facility for a remote operator's terminal was built into the control software and a serial interface card was purchased and installed to facilitate communication to the remote terminal. Installation was not completed, however, as it was reported during these modifications that the remote terminal would not be used by Transport Canada Information Counter personnel at this time.

   Prior to halting work on the remote terminal, a program interrupt strategy was investigated to enable access to the remote terminal. This would enable start-up only from the main terminal, followed by transfer of control to the remote terminal. This was seen to be necessary in order to avoid breaks in the program, which could be followed by unauthorized changes to data or accidental removal of code at the DOS level. However, there are major difficulties in developing this strategy, caused by the undocumented library calls described above.

   It is recommended, however, that when a Communi-Caid operator is no longer employed to be at the site, the use of an auxiliary control terminal should not be pursued, as this complicates operations unnecessarily. Rather, the main control terminal and computer should be removed to a remote site and the communications lines to the user's monitor and keyboard should be extended to reach from the kiosk to the site of the computer and main terminal. However, it may be possible to install more than one user station operating on a time sharing basis from the same master computer, but this must be verified.

5. Modifications to the user's keyboard to add comma, period and erase key were not carried out as, according to Teklogix Inc. this would involve complete redesign of the keyboard, which is controlled by an EPROM which contains special keyboard instructions. The feasibility of installing a different keyboard was not pursued further, owing to time and budget restrictions.

6. All reference to Expo 86, both visual and audio, was removed. Visual texts referring to associations for the disabled in the Vancouver area were expanded and updated. All references to the "operator" were changed to "agent" in visual and audio modes.

7. Control codes were installed in the program, which, when invoked by the operator, allow such operations as tracing errors in both visual and audio data, initiating the program in the absence of a trigger from the hook switch or the light sensors, and the use of the audio in the absence of initiating commands from the keyboard. Delays following failures to receive a response from the user's keyboard were extended to two minutes in the visual mode. If a user leaves the kiosk, the system is immediately reset to the start (see below).

III. CHANGES TO TAPE LOOP AND INTRODUCTION

1. In order to coordinate the introductory tape loop and visual information, the tape loop that was triggered by the light sensors upon entering the kiosk was replaced by digitally recorded speech stored in the computer's memory. A peripheral interface board containing an A/D converter and a D/A converter was supplied by CSTR for this purpose. When the light beams are broken, a triggering voltage is sent to the A/D converter which starts the program with the digital speech and introductory visual menus. If the user leaves the kiosk, the triggering voltage to the A/D converter is set to zero and the system in reset to the start. There are some details of implementation of the triggering mechanism that are to be improved upon over the next few weeks.

   Upon triggering, the visual introductory screen appears (if not already on the screen, see below) and the digital speech data comprising the introduction are sent to the D/A converter and out to the amplifier and speaker . The digital data includes introductory messages and instructions for general use in both English and French. It takes up 1.2 Meg of storage, representing a total of 2.5 minutes of speech and is stored on the fixed disk. The digital speech data are also channeled to the headphones so that if the user were to put the headphones on before the introduction is finished, the audio information is still available. However, some work is required to correct the amplifiers before this is fully implemented.

2. The introductory visual screens were changed to show introductory messages simultaneously in English and French on the upper half on the screen, which is split vertically. At the bottom half of the screen the message "COMMUNI-CAID" appears in large letters, surrounded by the international symbols supplied. The bottom half of the screen is replaced at regular intervals with a graphic layout of the buttons on the console. Large text instructions in black indicate that the top button should be pressed for English and the bottom should be pressed for French. The screens are white background with dark blue or black lettering. The "COMMUNI-CAID" lettering and the international symbols are in bright blue and the panel illustrations are in red and blue, the actual colours of the buttons.

3. The program was designed so that no entry to the main menu of information can take place until selection of English or French is made. Upon triggering, the panel illustration appears on the screen and the first part on the digitally recorded introduction is spoken, including audio instructions to the user to select English or French by pressing the appropriate button. Once the selection is made, the digital audio introduction continues only in the language selected. Provision is also made in the Main Menu, both visual and audio, for changing to the alternate language. If the headphones are picked up, the hook switch (to be installed soon) signals the system to commence in audio mode, passing the synthetic speech to the headphones once the audio introduction is finished.

IV. CHANGES TO VISUAL INFORMATION

1. All 400 visual screens were modified to show black lettering on white background. Dark blue lettering was used in some cases to draw attention. Bold style lettering is not available other than through the use of oversized characters, which tend to throw off character spacing and make the full text difficult to read.

2. Visual texts were modified to remove redundant information and to make the text into a point form or list format. Some text screens were split into two files to avoid excessive information on the screen. While this work is incomplete, Jean Brighouse has been trained to edit the text data files so that she may complete the modifications.

3. Maps and figures were adjusted to show bright blue on a white background. Some errors in the original maps must be corrected, but the format for doing this has been worked out and passed on to Ms. Brighouse, who has been trained to make these changes as well.

4. Because of the design of the Gigatek monitor, the white background is not pure white, but rather a light blue-grey shade. It is understood that the monitor is protected from excessive brightness which may cause screen burning. A pure black/white contraxt is therefore not possible.

   It was found that the use of a white background greatly reduced reflected glare from lights behind the user. However, in the Communi-Caid installation, the angle of the Gigatek monitor and the presence of lighted signs behind the user at the Transport Canada Information Counter still causes glare to be reflected from the screen.

5. A telephone survey of parapalegic associations was conducted to determine whether the screen keyboard used for communicating with the operator should be the "querty" format or the alphabetically-ordered keypad format. All respondents felt that the keypad format would be intuitively easier to use, as visual location of letters is more rapid. Comments were that (1) the "querty" format assumes experience with a typewriter or terminal, which is not often the case for those with manual disabilities and (2) such knowledge is

reinforced by touch, not visual reinforcement. We also found that the keypad format was easier to describe to the user, as the use of the arrow keys for vertical and horizontal movement is straightforward. In the "querty" format, use of the up or down arrows rarely results in vertical movement of the cursor. The "querty" keyboard on the screen was therefore removed and the keypad format was retained.

6. The visual communications screens for the user and operator, with information appearing in one screen being transferred to the other, were made more functional by using a half screen scrolling operation. Single line scrolling of the full page is much more complicated because it means that both send and receive screens on both terminals must be updated regularly, which is too slow to be practical when one screen writes to a graphics interpreter.

7. Instructions in the locations of printouts were simplified. A light was installed to draw attention to the printout. Unfortunately, there is no port available through the peripheral I/O interface (controlling user keyboard, buttons, hookswitch, etc.) to turn this light on only when a printout is generated, unless the light that calls the operator is removed. It was felt that in the current format it was still valuable to have the ability to call the operator, so the printout light is left permanently on when the system is running.

V. CHANGES TO SYNTHETIC SPEECH FOR AUDIO OUTPUT

1. All synthetic speech data were simplified to accelerate information delivery, using point form delivery where possible. At the head of all menus, instructions to press the select key after hearing an item are stated, instead of repeating these instructions with each item. Following each menu or list, the key words are repeated in audio if no selection has been made, rather than repeating the complete list in full. Instructions to replace the headphones to its hanger when finished were added to the end of the menus, once again being output only if no selection is made.

2. Large key words now appear on the screen in black on white, accompanying every item in the audio menus. (Previously only the menu head was displayed as the key word). These key words are repeated on the screen as they are repeated in audio if no selection has been made. Because of the requirement of large key words, it was not possible to leave more than one key word, corresponding to more than one menu item, on the screen at the same time. Some work is required to fine tune the location of key words on the screen, but this is currently being completed by Ms. Brighouse, who is also modifying delays between items of audio data in the sentences that have been added or modified.

3. Because of time taken to investigate and write preliminary software to accomodate an auxiliary control terminal, there was not sufficient time remaining to install a "talking clock". However, we hope to undertake this development as time permits, so that it will be available for the next stage of product improvement.

VI. CONCLUSION

In the two week period from January 5 to January 16, 1987, we will be making adjustments to the light sensor triggering device to optimize performance, as there are difficulties with false triggering and failure to trigger that must be corrected. Also, the amplifiers and volume control must be adjusted and improved. We will be installing a new amplifier to improve quality, and a mixer to allow the digitized audio introduction to be played simultaneously on the speaker and headphones without reduction is quality.

The modifications that have been undertaken appear to make a significant improvement in the flow and access of information in the Communi-Caid system. However, design changes are required to simplify access further and provide additional information, to the degree that a superisor is no longer required. It is expected that the simplification of operations through the removal of the user keyboard and the limitation of user command keys to two vertical movement keys and a select key would make the system more easily understood. With the addition of airline information that is accessible directly through the computer, the system may be a valuable source of information for both normal and disabled travellers.

Consideration must also be given to the separation of the audio and the visual information components into two separate systems for simplicity. As the addition of synthetic speech in several languages is expensive considering the state of the technology (many languages have not yet been worked on to the degree that anything but low quality synthetic speech is available), it is also valuable to consider other forms of speech compression that do not require the use of linguistic rules.

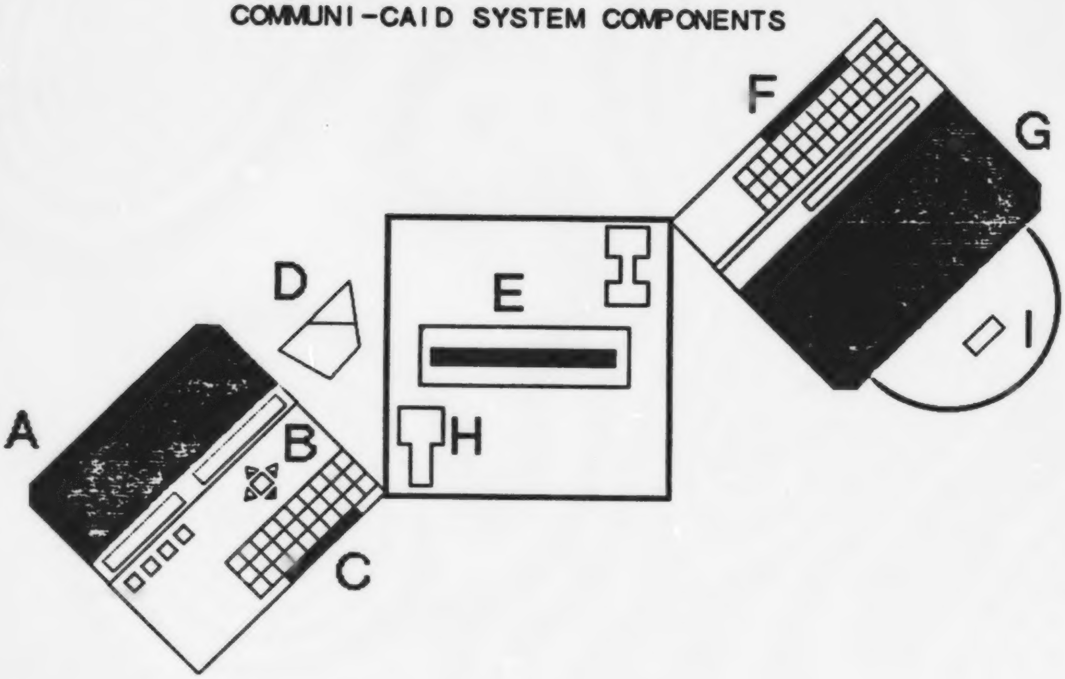
This implies the use of extensive storage capabilities to hold complete sentences, where complete sentences should be used as often as possible to maintain quality. (Using standard high quality compression techniques, the information stored in the current audio system would require approximately 20 Megabytes of storage per language. This would have to be doubled if airline information were added.) However, such an approach is well within CSTR's capabilities, with access available to large storage system technology and, through our associated department of linguistics, to native speakers and translators.

Alternatively, CSTR is currently updating its LPC speech compression technology, which may be used either to produce synthetic speech in conjunction with language-specific control rules, or to produce compressed phrases and sentences that do not require extensive rules to produce natural sounding output. While we are not yet in the position to quote costs for production, we expect that over the next three months we will develop the capability to automatically compress speech samples, to the degree that editing is not required to maintain current (perhaps improved) quality. Compression using our new techniques is expected to be in the order of 60:1, meaning that 20 Megabytes of storage can be compressed to 333 Kilobytes. Several speech synthesis chips and digital signal processing chips are being investigated for this application.

APPENDIX F

MENU SAMPLES, ENGLISH AND FRENCH

COMMUNI-CAID SYSTEM COMPONENTS



A : YOUR MONITOR SCREEN
B : YOUR CONTROL PAD FOR CURSOR
C : YOUR KEYBOARD
D : MONITOR SCREEN FOR FLIGHT DEPARTURE / ARRIVAL

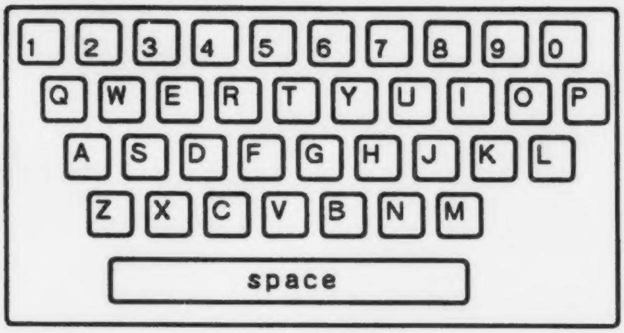
E : PAPER PRINTER
F : OPERATOR'S KEYBOARD
G : OPERATOR'S MONITOR
H : HAND PHONE
I : HOTEL PHONE

enuc TO START, PUSH THE BLUE BUTTON . ■

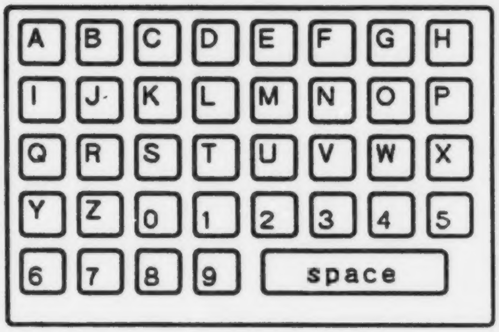
TO COMMUNICATE WITH AN OPERATOR, YOU CAN USE ONE
OF THREE KEYBOARDS .

ONE KEYBOARD IS LOCATED ON THE TABLE IN FRONT OF YOU .
THE OTHER TWO ARE LOCATED ON THE MONITOR SCREEN .

TYPE A


1 2 3 4 5 6 7 8 9 0
Q W E R T Y U I O P
A S D F G H J K L
Z X C V B N M
space

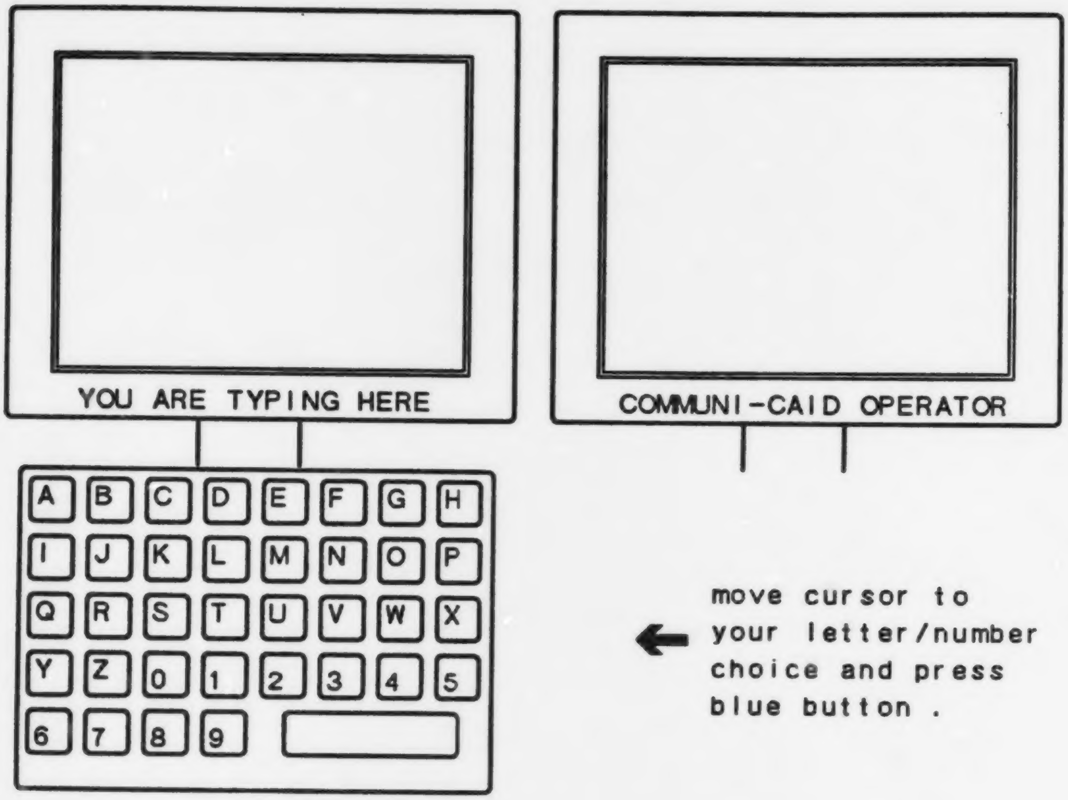
TYPE B


A B C D E F G H
I J K L M N O P
Q R S T U V W X
Y Z 0 1 2 3 4 5
6 7 8 9
space

TO START, PRESS BLUE BUTTON .

menud

THIS IS THE TYPE "B" KEYBOARD .


YOU ARE TYPING HERE
COMMUNI-CAID OPERATOR
A B C D E F G H
I J K L M N O P
Q R S T U V W X
Y Z 0 1 2 3 4 5
6 7 8 9

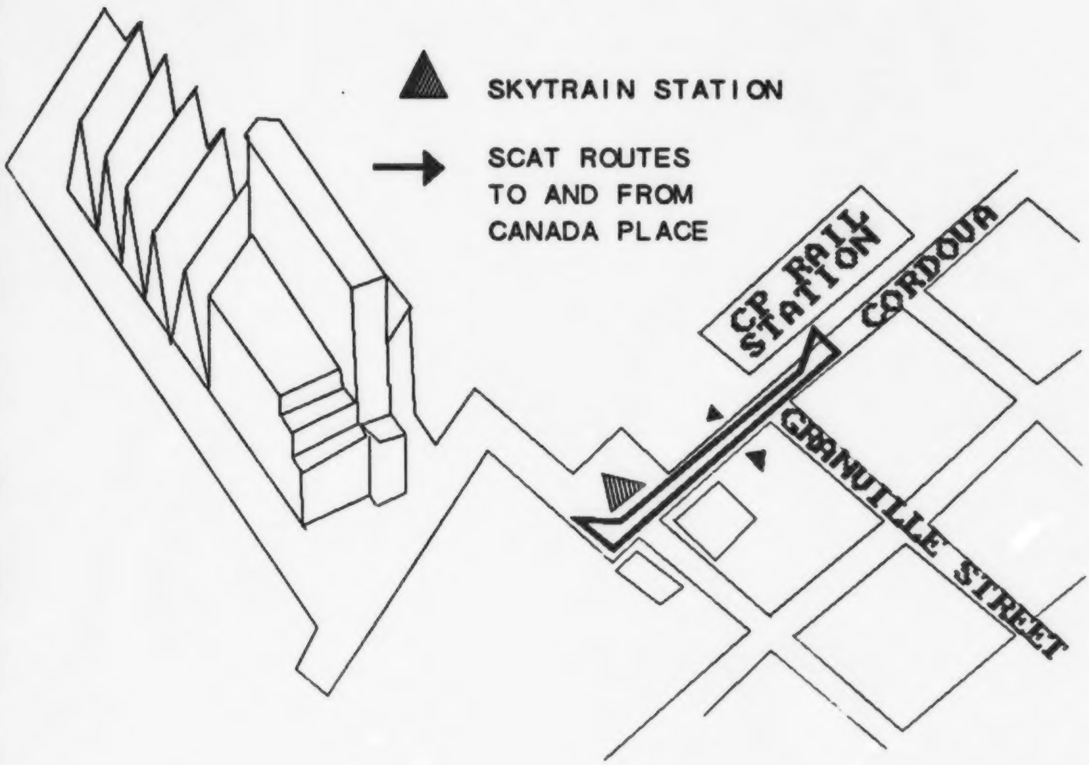
move cursor to your letter/number choice and press blue button .

FOR RETURN TO PREVIOUS MENU .... ■

FOR RETURN TO START .... ■

TYPEB MOVE CURSOR TO YOUR CHOICE AND PRESS BLUE BUTTON .

MAP FOR CANADA PLACE

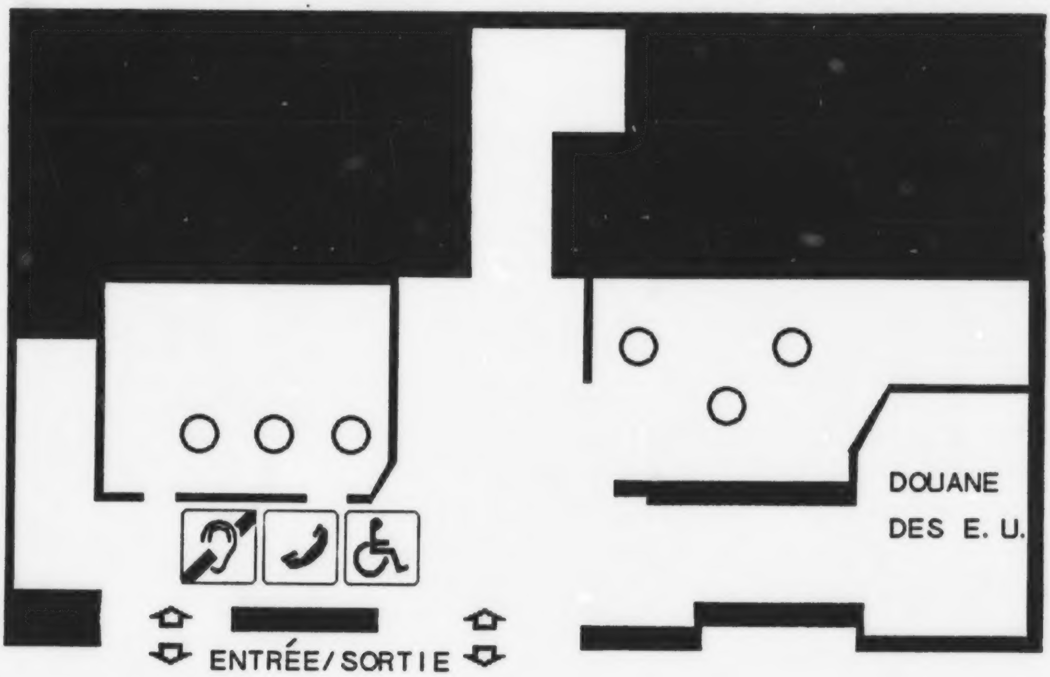

▲ SKYTRAIN STATION
→ SCAT ROUTES TO AND FROM CANADA PLACE
CP RAIL STATION
CORDOVA
GRANVILLE STREET

Menu 531

AÉROPORT DE VANCOUVER
TÉLÉPHONE À VOLUME RÉGLABLE

☎ ♿

VEAU 2: ARRIVÉES INTÉRIEURES ET DÉPARTS POUR LES ÉTATS-UNIS


DOUANE
DES E. U.
ENTRÉE/SORTIE

frc. 242

AUTOBUS POUR VICTORIA
[PAR TRAVERSIER]

🚌 **PCL** ♿

VOUS ÊTES MAINTENANT AU NIVEAU 3 .

LA COMPAGNIE D'AUTOBUS PACIFIC COACH LINES OFFRE LE SERVICE JUSQU'AU CENTRE-VILLE DE VICTORIA. PRENDRE LE SERVICE DE NAVETTE JUSQU'AU DELTA AIRPORT INN ET TRANSFÉRER AVEC L'AUTOBUS DE PACIFIC COACH LINES . CES AUTOBUS PARTENT DU DELTA INN TOUTES LES HEURES À L'HEURE JUSTE DE 07:00 À 21:00 HEURES . LE TARIF D'UN ALLER SIMPLE EST DE $14.25 ET COMPREND LE COÛT DU TRAVERSIER DE TSAWWASSEN JUSQU'À SWARTZ BAY . LE TRAVERSIER OFFRE UN SERVICE DE CAFÉTÉRIA ET UN RESTAURANT . LA DURÉE DU VOYAGE ENTRE L'AÉROPORT DE VANCOUVER ET LE CENTRE-VILLE DE VICTORIA EST DE 3-4 HEURES . POUR VOUS RENDRE AU DELTA AIRPORT INN ET AU POINT DE TRANSFERT DE PACIFIC COACH LINE, PRENDRE LE SERVICE DE NAVETTE AU NIVEAU 1 .

fren 35

SERVICES OFFERTS PAR LES ASSOCIATIONS

DES SERVICES SONT DISPONIBLES POUR LES MAL-ENTENDANTS . PRIÈRE DE TÉLÉPHONER AU 738-1213 [VOIX] OU AU 738 - 3332 [TDD] .

POUR OBTENIR DES INFORMATIONS DE L'ASSOCIATION CANADIENNE DE PARAPLÉGIQUES , TÉLÉPHONER AU 324 - 3611 .

POUR OBTENIR L'AIDE DE L'INSTITUT CANADIEN DES AVEUGLES, [INCA] TÉLÉPHONER AU 321 - 2311 .

FREN 70

APPENDIX G

OPERATORS OBSERVATION, SAMPLES

OPERATOR'S RECORD

DATE: Sept 20/86

Traveler Profile group of 6 (one blind & deaf) ✓ Sol. ___ Unsol.

___ Young ✓ Adult ___ Elderly

3 Male 3 Female ___ Accompanied ✓ Unaccompanied

Disability

___ Sight ___ Speech ✓ Hearing

___ Use of Visual Ear ___ Use of Visual Ear

___ Manipulation (fingers, hand, arm, artificial limb) ___ Mobility (wheelchair, crutches, cane)

Length of time at COMMUNI-CAID 30 min

Printout received ✓ Yes ___ No

Comments

Traveler's main difficulties using COMMUNI-CAID, comments and suggestions:

one of the group used the system while the others looked on & exchanged comments (in sign) The user had a bit of trouble understanding how to access the information on the START LIST but once I showed her the instructions @ the bottom of the page she had no trouble. Again system jammed when she chose Flight schedule information. Thought it was great & fairly easy to use. & couldn't think of anything particular that she thought should be changed. The others were pretty shy about trying out the system, as they'd not had any experience c̄ computers before and had seen more, or less what it did by watching this one woman.

Operator's comments:

One of the deaf women described what was going on to the blind/deaf man (signing on his hands) & he seemed very interested by the idea.

COMMENT NOT ASSOCIATED WITH THIS GROUP BUT IMPORTANT: We have many able bodied people coming in to ask "Where do I get a wheelchair for my mother etc?" So I ~~g~~ suggest that of wheelchair procedures followed by the airlines this is perhaps the most important (location - where to go, what counter with CP Air etc to approach for a wheelchair) aspect of this particular set of information (procedures) and should be included in the system.

Sol.

[illegible]. Aug-21
1005am - 1015am

OPERATOR'S RECORD

Traveler Profile

○ Young ● Adult ○ Elderly

● Male ○ Female ● Accompanied ○ Unaccompanied

in airport but unaccompanied in booth.

Disability

○ Sight ○ Speech ○ Hearing

○ Use of Visual Ear ○ Use of Visual Ear

● Manipulation (fingers, hand, [✓ arm], artificial limb) weak but could reach w/ right hand.

● Mobility ([✓ Wheelchair], crutches, cane)

Length of time at COMMUNI-CAID: 10 mins.

Printout received ○ Yes ● No

Comments

Traveler's main difficulties using COMMUNI-CAID:

"not sure how to move cursor - used to having 'cursor control buttons' closer to him. Suggests that they be closer to user esp. for some quadriplegics who may not have a great range of movement. // Says system is easy to read + easy to

~~Operator's~~ comments: understand // would like to see at least one on every floor of every airport // Travels by himself + would definitely use centres if he knew they were there - Would like to see accessible entertainment as well as transportation and accommodation

Comments ~~from other travelers:~~ // Did not have trouble w/ lip but said that "any more would have been a problem" (i.e. height to the lip) // Great to have flight info all in one place

// came back a couple hours later for info on washrooms.

- ~~couldn't figure out how to get to keyboard.~~

EVALUATION OF COMMUNI-CAID AUDIO MENUS BY SIGHT IMPAIRED USERS

(September 24/86)

The second evaluator, B.A., is also in his sixties, has had limited vision since childhood. His sight is currently at about 10%. B.A. does not use a white cane nor does he require assistance in getting around. He travels once or twice a year and claims his only problem in the airport is reading the signs.

To begin the evaluation, B.A. was left alone to use Communi-caid without help from an operator. On discussing this initial trial B.A. commented on the fact that he is a very impatient man and found accessing information on Communi-caid too slow. He wondered if there was an option for cancelling a choice made in error, or for backtracking or continuing forward. He suggested that he would prefer a "quick" list that he could listen to and then push the number of his choice

In using the audio menus, B.A. had trouble with the timing of the system for making a choice. As with E.C., I had to explain that he must hear a tone for the choice to have been registered by the computer. He had no trouble reading the enlarged key words on the screen though he could not read the visual menus at all. He could also read the Flight schedules monitor if he strained but did not trust his accuracy. Apparently he had no difficulty hearing and understanding the synthetic voice (the airport was fairly quiet that day).

B.A. checked out the location of the telephone, which he had trouble discerning from the wall and suggested a better place for it would be on the table top. Then it would be within easy reach for dialling; sight impaired users could practice dialling a number comfortably if they needed to. He suggested that if labels were installed, he prefered braille because it is easier and faster to read than raised letters. However, he felt if a verbal orientation were included, the labels, which he considered costly, would not be necessary.

The only problem B.A. found in getting information with the system, was the fact that is time consuming. He could use and follow the directions well, but claims he would prefer to approach someone for directions.

Though using sound feedback to locate objects is not a personal issue, B.A. commented on the problem other visually impaired people, with less sight than himself, have in an environment like the airport. The noise distortion interferes with one's normal orientation sense.
He also mentioned that most sight impaired people cannot serve themselves independently in a cafeteria; conversely, B.A. says he couldn't afford to eat in the Sea Island Lounge.

Though B.A. can find his way around the airport without any hassle, he cannot distinguish the difference between the international symbols for men's and ladies' washrooms. These are not spelled out in letters nor are they marked with tactile labels. Many signs are not distinctive or contrastive enough to be clearly distinguished by many sight impaired people.

Remarking once again on his own impatience with things, B.A. mentioned that other people, particularly younger, may have a different attitude to this form of independence (i.e. Communi-caid). He added that if you gather 20 blind people together, you are going to have 20 different abilities and personal preferences.

EVALUATION OF COMMUNI-CAID AUDIO MENUS
BY SIGHT IMPAIRED USERS
(September 27/86)

The third evaluator is a woman in her mid sixties, hereafter known as E.H. Has retinitis pigmentosa, a degenerative disease which has stabilized at about 2 percent. Has no peripheral vision. Always uses white cane to help her get around and is confident with it. Very independent and likes the idea of any system which will help blind/visually impaired people to be more independent. Travels by air about 2 - 3 times a year. Usually arranges own transportation,& is escorted around the airport, both when departing and arriving, by airline attendants.

To begin the evaluation, E.H. was asked to enter the booth, go through the program by herself, and keep in mind any questions/suggestions/criticisms she came up with along the way. She listened to audio program very thoroughly. We then discussed her initial and overall impressions of both the booth and the program, and she offered some suggestions as to improvements/additions which she felt would be helpful.

-E.H. located handphone easily using tapeloop directions. Was somewhat confused by hearing the words "blue button" in tapeloop, followed by french. Assumed that if user wanted info in french, would press blue button. Thought she would be expected to use the blue button for something at some point and wondered how we expected her to know which one was the blue one. Also would have liked to know the purpose of the "large buttons with the arrows."

-E.H. began listening before she sat down, then became confused because she had located the chair, was trying to sit down, listen and arrange her personal belongings at the same time, and the audio exited into french. At this point she asked if there were an option to "back up" and start the program again.

-E.H. pushed buttons several times before asking for any help. Later revealed that the system didn't seem to be responding, and rather than believing the system wasn't working, she kept at it when it said "press any key..." Finally figured out that if she waited 5 - 6 seconds after the instruction and pressed, she would hear a tone and the program would continue. ie. She did figure out that there was a time lapse within which a key should be pressed. Feels that this should be included in the instructions, because users "may get frustrated and give up before they realize how to use the system."

-E.H. went through all choices on main menu systematically. Handled operator assistance well using flight schedule option. (Thought up a sample question she would ask when the operator was connected.) Was surprised to find that the "operator" was one of us. Thought he/she would be a telephone operator who gave details on flights, and with whom user would actually speak.

-E.H. called up operator assistance a second time by error, thinking she would move on to the next option because she had already listened to flight information.

-E.H.'s sample question when moving into airport facilities was wanting to know where the bar was. (There are no bars listed on the audio menu, including the Sea Island, which IS listed as a restaurant.) She did call for operator assistance at this point.

-E.H. was frustrated that she had to return to "square one" after she had listened to the details on one option in order to continue with the next option. At first thought she had made some kind of mistake but realized that this was the computer set up and said that it was way too time consuming. Suggested a quick read through of all the options and then an option to hear the one you wanted without all the rest. (Perhaps "pick the number of the choice you want")

-when E.H. tried the ground transportation menu, the first thing she tried to access was Pacific Transit Co-Op, which is not on the system. Believes this is the most vital means of transportation for disabled people to know about in Vancouver, and if there is a similar system in other cities it should be included. Being an independent sort of person, she arranges her own transportation when she travels, and finding an inexpensive means of getting around is of utmost importance - taxis can get very expensive. "Any transportation specially for the handicapped should be listed first."

-further to this, E.H. feels that all transportation listed on a system like this should say whether it will take wheelchairs OR NOT, at the same time that the bus or shuttle etc. is being described. This would save time & trouble because a person could tell immediately who to call & WHO NOT to call.

-E.H. is a frequent traveller and knows basically where the airline counters are, so we didn't discuss this option at any length. Also, since Expo is almost over and the menus will likely be removed after the middle of October, we didn't discuss this much either. E.H. did pick up on the fact that the "Get Away Vans" for the disabled at Expo were not in the system.

-Re: Giving directions to the ends of level 3 in this airport: E.H. thinks it is easier to walk along the front corridor than the back one (called the "main corridor" in the menus) for three reasons. First, there are pillars and other obstacles down the back corridor which a blind person will inevitably bump into. Second, when leaving Communi-Caid, it would be easier to turn right or left and walk straight ahead and turn at the end of the hall, because it is easier to tell where the "end" is, since you run into a counter. Third, walking straight ahead at the beginning of a journey is easier than taking a "jog" and then trying to straighten yourself out for a long stretch.

-When E.H. accessed the Hotels menu, the information went by too fast and wasn't clear, and she hoped to be able to get a repeat right away. However, realizing she would have to listen to the entire list first before getting a repeat, she became fed up and went on to the next option. She suggested here that "someone with less patience than I - and I have a lot - would have given up because of that (the obligatory going back through the whole menu again in order to continue on and/or get your info repeated) long ago." She suggested here that there be reverse & repeat options so that the user could go back immediately and repeat JUST the bit of information they missed. Otherwise it is a very "long & drawn out process of getting information."

-At first, E.H. thought the voice she was hearing was a human voice, but when it started to give numbers (eg. phone numbers) it became obvious that it was a "computer voice" because the numbers were consistently slurred. E.H. knows the number to the C.N.I.B. but said that she wouldn't have understood it had she not known it already. Clarity of numbers given on an audio system is extremely important because there is no context from which to determine their "meaning". For a blind person to travel independently using a system like this, the numbers MUST be clear or it defeats the purpose of the system, ie she would have to end up asking someone to look up the number, or dial directory assistance.

-E.H. kept her left ear plugged throughout her audio listening time. She didn't want to miss anything for fear of having to go through the whole system again to access what she wanted, and the slurred quality of the synthetic voice together with the airport noise made it difficult for her to hear. She felt she had to concentrate very hard to hear what was said the first time, and this tended to make her anxious. Suggests a "light headset" to at least cut down outside interference.

-Re. info on Associations for the blind & paraplegic: At first, E.H. felt that having two menus for this option was redundant, and that the phone numbers could be put on the main menu to save time. However, she changed her mind about this, because what she would really find useful in an unfamiliar city are the location of the C.N.I.B. and a list of their services & equipment, such as cane repairs & replacement, talking books & tapes, tape player repairs, sunglasses & sunshades, & support groups.

-Re: Printouts. E.H. suggested having a notepad so sighted users could record their information. She did not realize there was a printer because nothing on the audio menu states this. Suggested a notation to that effect, perhaps in the introduction, because a sighted person travelling with a blind person would be able to use printouts if they knew they could get them through the visual menus. E.H. pointed out that if she were with a somewhat sighted traveller, they would not necessarily go straight to the visual menu because she likes to be the one who gathers information.

-Re: The local telephone. As soon as the audio menu gave E.H. a phone number, she wished to find out where the telephone was, because its location is NOT mentioned in the tapeloop, the introduction or the orientation. At first assumed it could be accessed through the handphone. Didn't think, however, that there were any numbers on the keyboard. Required an operator to direct her to the phone. Had to get up, stumble to the desk on her right, fumble on the desk and then on the wall to finally locate the phone. Suggested that it be on the wall NEAREST the user, on his/her left. If it had to be on the right side, perhaps on the desk rather than on the wall because a desk phone is easier to reach. No matter where it is located, it should be a CONTRASTING COLOUR to the wall or desk, with CONTRASTING COLOUR KEYS. eg. light wall, dark phone, light keys. Also said that larger keys would be helpful but not necessary.

-Re: Keyboard colours - keys should contrast with background panel, eg. white keys on the existing red panel would be ok.

-For the visually impaired with some residual vision, E.H. feels the lighting can make all the difference to a system like this. A brighter overall light, or at least a brighter light over the desk, would be helpful. Said, "the little light off to the left wasn't much help at all", because she would have to have a sighted person read the airline monitor panel and monitor for her anyway.

-E.H. liked the connection between the visual screen & audio menus. At first, she thought that the visual screen was saying exactly what the audio was saying. Therefore, the large print key words weren't helpful to her, but she thought they would be a good guide to people with more vision.

-Since E.H. relies primarily on airline attendants as escorts in airports, she feels that they should be the ones whose job it is to tell disabled travellers where the Communi-Caid system is in the airport if they need it. Would like to see it on arrivals level of airports in cities she doesn't know, making it as easy as possible to locate &/or be guided to.

CONCLUDING REMARKS

E.H. loves the idea of Communi-Caid and thinks it would be a great asset to visually impaired travellers. She points out that blind people all have different needs and capabilities, as do all individuals, and thinks Communi-Caid is on the right track to serving as many of these as possible. Would like to see a Communi-Caid centre where more than one person could get information at the same time. Thinks that young blind people are a lot more independence oriented than a lot of older blind people and that they would likely use systems like this in the future.